Booting A PC Without A Keyboard

SILICON CHIP

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PROJECTS TO BUILD - SERVICING - COMPUTERS - VINTAGE RADIO - AUTO ELECTRONICS

Build your own LOUDSPEAKERS

- Electronic Braking In Cars
- We Tour The Rooty Hill Steel Mill
- PLUS:

10-Channel Infrared Remote Control

To understand why $6,843 is a fair price to pay for VAF kit speakers, read 580 words from a violinist who can't use a screwdriver.

The following is an excerpt from a review which appeared in Audio Video Lifestyle Consumer Guide '99 by Sian O'Neale.

"Phillip Vafiadis is the creative talent behind the brand and his aim with VAF Research is to market kit loudspeakers of uncompromising quality at the serious end of the hi-fi market.

The VAF range is priced from $312 a pair right up to $8,863 a pair*, so we're talking serious money here for serious equipment.

We at AVL magazine have been particularly impressed with DC-X series.

These kit loudspeakers are not the standard packages from consumer electronics stores. In fact, you won't find these products in any store. The company prefers to cut out the middle-men and save buyers money, so every product is available factory-direct.

The VAF Signature series includes the Signature 1-66 and 1091 loudspeakers. Taking delivery of the 120kg 1-66 floorstanding speakers is something of an experience; I have never seen such an imposing crate for a pair of loudspeakers before. Fortunately my brother Crispin is capable with the screwdriver and we took out the massive 1-66s. You will need quite a bit of muscle and help to unpack these speakers and get them where you want them. The engineering and attention to finish that has gone into these fully assembled VAF Research 1-66s is simply awesome.

These elegant but powerful looking loudspeakers come with removable velcro attached grilles in a 3-way design; a 210mm hard paper bass driver with solid copper phase plugs and a 25mm double chamber sonotex dome tweeter with a pure silver wire voice coil. Turn the speakers around and you have very high quality gold plated binding posts which allow for bi-wiring and tri-wiring.

The same meticulous attention to detail and build quality also goes into the smaller 1-91 models, three of which are presented as left and right rear surrounds and a centre channel speaker for home theatre use (which has a custom-designed grille for a centre channel speaker). But the 1-91 loudspeakers have been designed to also perform as high quality studio monitors with the same superb sound as the 1-66s.

The speakers were designed to be used close to a rear wall and that's how customers use them, ideally 15cm-40cm from the nearest wall. But I think the speakers sound better when they can breathe more easily. Find the right position for the room and you will be richly rewarded.

The big VAFs deliver a stunning soundstage which is wonderfully insightful and involving. Large scale orchestral works have a level of depth and accuracy that only the best loudspeakers can manage.

As a violinist, I am often left unimpressed with the sound of the violin through so many loudspeakers (even high-end models), but here the presentation is accurate and engrossing. Instrument separation between different members of the orchestra is faultless.

This is particularly obvious when listening to Hans Zimmer's evocative soundtrack for The Thin Red Line in which quiet, gentle music provides so much power and atmosphere.

As a system for home theatre, together with the smaller satellite 1-91s, VAF has assembled an incredible system. Bass extension from the 1-66s is awesome; deep and thrilling, which is ideal for action blockbusters such as Speed, Twister or Titanic (you don't just watch the ship sink - you feel it through the floorboards). The centre channel speaker locks dialogue firmly into place and steers the sound with maximum impact; dialogue in Speed comes across as frantic as the driving. Full marks."

* Figures amended to reflect current pricing.

For the entire transcript of this review or information on our 14 models contact VAF Research and ask for your copy of "What the Critics Say". Free call 1800 818 882. Email vaf@vaf.com.au or surf www.vaf.com.au

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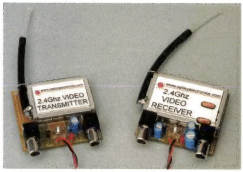

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PUBLISHER'S LETTER

Electronic braking in cars: is it a good idea?

One of the feature stories this month is about the introduction of electronic braking in cars, specifically in the new Mercedes SL class convertible. The story is interesting in that it represents an integration of several braking and traction control systems in cars. I have always felt that ABS (anti-skid braking system) and normal power boosters should be integrated rather than being two separate systems. Such an integrated system would be cheaper and more compact. But now this Bosch system takes the integration concept much further, as described on page 6 of this issue.

However, while the technology is very interesting, I do have misgivings about it and they relate to the special features or modes that have been grafted onto the system. For example, there is the smooth stop system and the brake drying function. While these may be highly effective, is there not a risk that someone who became used to driving such a car would no longer be safe when they stepped into a lesser equipped vehicle?

Would they no longer be capable of braking to a smooth stop or be quite dangerous in wet weather, being unaware that a normal car's brakes don't work when they are wet? And would they be more likely to run into the car in front because they had become used to their electronic guardian angel compensating for the dangerous habit of "tail-gating"?

This is quite a different situation from the comparison of an ABS-equipped car with one with ordinary brakes. ABS only comes into operation during emergency braking and at other times, an ABS-equipped car brakes exactly the same as any other disc-braked car.

In more general terms, there are huge numbers of drivers today who have only ever driven automatic cars and would be unable to drive a car with a manual gearbox. Of course, most people accept that limitation and are happy to only drive cars with automatic transmission. But braking is more basic; if you can't stop safely when you jump into another car, there is a big problem.

I suppose that this is the drawback of any new automotive technology - its introduction will effectively reduce driving skills while still giving an overall improvement in safety and driving comfort.

Having said that, I still think that this new Mercedes car has too many braking frills and that these are not likely to filter down to less expensive cars as electronic braking becomes more widespread.

It's interesting that it still relies on hydraulic brake fluid though, isn't it? Apparently, a "pure" electric braking system is not yet on the cards.

Leo Simpson

SILICON CHIP MAILBAG

Electronics Australia copyright

I was delighted to hear that Silicon Chip Publications has purchased "Electronics Australia" magazine. Like you, I was saddened to see it cease publication in 2001.

Please accept my best wishes on behalf of all of us at Jaycar Electronics. I look forward to resuming my monthly EA read!

Gary Johnston,
Jaycar Electronics,
Silverwater, NSW.

More on DVD picture quality

I have read with interest some of the recent correspondence in Mailbag with regard to the perceived lack of quality provided by the DVD format and hope that this note will help to clear up matters for the correspondents. I would first direct them to the DVD FAQ at:

www.dvddemystified.com/dvdfaq.html

Simon Kareh in the September 2001 edition of SILICON CHIP raises two issues:

(1) The fact that Titanic when shown in full screen was not missing any of the picture compared to widescreen and in fact had more picture information.

The reason that Titanic (and some other films) have more picture when shown in full screen 4:3 mode is because of the way it was originally shot on film. Not all films are like this. Directors generally (although not all of them) shoot the film for a rectangular cinema screen (you may have seen footage of a film being shot with the director looking at a video monitor displaying a 4:3 image but with a white rectangular "cinema screen" shaped marking across the middle of the screen).

Typically crew members, boom microphones, etc, that appear outside the rectangle are ignored, because the director knows that the film will be matted for the rectangular shape of a cinema screen. Some directors shoot with release-to-video in mind as well, so while the shot is composed for the rectangular screen, the director makes sure that there is nothing untoward in the frame outside the rectangle.

Widescreen does not automatically mean you are getting more picture (although you are getting the picture the way it was intended) just as full screen does not automatically mean you are getting more picture.

(2) The issue of lines of resolution and NTSC/PAL differences is the other topic. The 500-line video resolution referred to in regard to DVD players is an old analog measurement of vertical black and white lines resolvable, not the horizontal scan lines. The DVD FAQ gives a full explanation but basically vertical lines are not the same as horizontal (scan) lines.

The 480 (visible) and 576 (visible) scan line NTSC/PAL difference still applies. Think of vertical lines as similar to a computer monitor's horizontal resolution (the 800 in 800 x 600). A DVD does approximately 500, while VHS does approximately 230. A DVDs actual on-disk resolution is 720 pixels wide by the PAL or NTSC number of scan lines.

With regard as to which is better, the NTSC disc with its higher frame rate or the PAL disc with its more scan lines, that is a whole separate debate that comes down to personal preference.

Brad Sheargold in the October 2001 issue of SILICON CHIP questions the quality of DVD after seeing a demonstration on a friend's plasma display. While it is true that there are quite a number of poorly encoded DVD's around, I would suggest that the problem Mr Sheargold was observing might have been to do with the nature of plasma display devices, or that particular device's calibration, than with any inherent flaw in the DVD format as a whole.

From my understanding, plasma devices currently are not very good at producing dark colours. They also tend to have a black that is not true black, rather a grey or brown (although both these characteristics are improving all the time). These characteristics are artefacts introduced by the display device itself and will serve to highlight any MPEG artefacts that may have been present on the disk, although generally artefacts seen are caused by display devices that have not been calibrated properly, have their "sharpness" control turned up, etc.

Another possibility is that the artefacts Mr Sheargold saw were intro-

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duced by some kind of low-quality scalar or line doubler/quadrupler or, the need for such a device. (Incidentally, the highest resolution Fujitsu plasma device I saw after a brief look at the Fujitsu website was capable of displaying 1024 x 1024, not 1 million x 1 million as his understandably enthusiastic friend told him).

The bottom line is that a bad DVD picture is not always the DVD's fault. I would suggest Mr Sheargold see if he can view those discs on a different display device and see if he notices the same problems.

I watch DVD's on my own modest CRT and regularly see them on a friend's projector system, and I can honestly say that the DVD on the projector is the best picture quality I have seen outside of a cinema (and even inside many of them!).

In response to John Richardson, from his letter in the October 2001 SILICON CHIP, I understand that the ABC has been having some teething problems with their new equipment (I have also noticed incorrect aspect ratios that suddenly change, etc).

Mr Richardson's points about the lack of some potential features being utilised have some validity, apart from the quick access – I can jump to chapter stops in DVDs very quickly (granted you do have to sit through the copyright screens on first loading some disks, but then you have to fast forward through them and promos on VHS tapes, so I doubt VHS is any quicker). I suppose it depends on what you define as "quick access".

In regards to the sound quality of DVD, unless you have a Dolby Digital and/or DTS capable sound system then you are only hearing the lowest quality sound that DVD can provide. I expect the DVD consortium will take it as a compliment that the lowest of the DVD is equal to the best of the VHS.

Sam Yates,
via email.

AVR ISP programmer software

I have some further information on the AVR ISP Programming Adapter featured in the October 2001 issue.

The software mentioned in the article ("AVR ISP", from Atmel) only works with Windows 95, 98 and Me (not NT4 or 2000). It also doesn't support some of the latest AVR microcontrollers.

I have discovered another software package that addresses the above issues and should be compatible with the hardware as presented. It is called PonyProg (of all things) and is available for free download from http://www.lancos.com

To configure PonyProg to work with the programming adapter, set it up for the "AVR ISP (STK200/300) parallel port interface" as described in the included documentation.

As a bonus, PonyProg should also work with the PIC Programmer and Testbed described in January 2001 (use the "JDM" programmer settings).

Peter Smith,
Narraweena, NSW.

In favour of backups

I always find your articles on computers and software interesting and quite useful but your frequent suggestion to 'wipe' your hard disk and start from scratch quite upsets me!

I can't imagine how you have avoided the serious trap in doing this. Reinstalling all your software is not a simple task, particularly if you have commercial software which you have paid good money for and upgraded frequently. Many programs require the previous version to be on the system before they will install the latest upgrade.

Just the thought of reinstalling all the versions is bad enough, however I am using one program that started life on 5.25-inch floppy disks! I do have a 5.25-inch drive but it is years since I used it and the disks are unlikely to be readable even if I could find them. Even the 3.5-inch drive is used so rarely it generally needs kicking to make it behave and I have a couple of programs that started life on them.

Please, in future, place a warning when you give this advice. For many people it may be OK but for some of us – well, it would be disastrous. Instead, I do wish you would suggest people make backups regularly. These days when most (if not all) of your readers probably have CD burners, backing up all the important parts of a hard disk system is not difficult.

I use an old system for backups. The hard disk is split into three partitions (I used to use two disks). The 'C' drive has the system and all programs. I do a backup of this when it is needed, after installing new software. The 'D' drive has all the important data; backup of that is daily if not more frequently. The 'E' drive is for 'junk'!

For added safety, a copy of the 'D' drive exists on two other computers. If you think that maybe I don't trust computers, well I don't. After 35 years of experience I have good reason not to .

Geoff Syme,
via email.

VideoSCope magnification

I have built, with slight modification, the excellent VideoSCope project published in the October 2001 issue of SILICON CHIP. My approach differed in that I used a "syringe" type approach, with the camera (Dick Smith Electronics Cat. L-5873) being on the end of the plunger which is 760mm long. I used a 50mm F1.2 lens from a Minolta SRT101 camera.

I am able to reproduce magnification of an EPROM similar to that shown in your article and when viewing a ruler I can get the markings of 1mm to appear full screen width on my 34cm TV (28.5cm horizontal). I intend to try the concept in my microscope and telescope as well.

My question is how do I determine the magnification I have achieved? One would think that if 1mm is shown over the width of 28.5cm then I have magnified the image by 285 but I question this as moving to a different, larger TV the magnification would increase just as the screen size increases.

I am interested in how the authors determined their shot of a silk screen was enlarged by a factor about 3200.

I think that this an excellent project. It was cheap for me as I had all the components, yet extremely practical. I can now show my 3-year old granddaughter things she would have difficulty seeing with my microscope.

Ken Fox,
Vermont South, Vic.

Comment: the effective magnification does depend on screen size. If you

have a bigger screen, you get a bigger image. As far as the figure of 3200 is concerned, perhaps the image was taken with a close-up lens.

Big acceptance of electronic equipment

In your December 2001 issue, you published my offer to pass on the electronic parts & instruments which I had accumulated 'over life". The response was amazing, exceeding my wildest expectations.

Unfortunately, because I was uncertain if there would be any interest, when an 'early bird' appeared on Tuesday morning, November 27th, and offered to take everything, I accepted, in case I got no more interest.

As a result, I have had to refuse many writers, many of whom I would have liked to satisfy. So, I apologise to all those who, though quick off the mark, were too slow.

I hope I have written to all who wrote to me. If I missed anyone, please accept my oversight. And to anyone who has not written but sees the offer, it is too late!

Pamela & Ewart Jones,
Coromandel Valley, SA.

MP3 Jukebox: have you tried MPXplay for DOS?

I read with interest your MP3 Jukebox project in the September & October 2001 issues. I note that you recommend a Pentium 133 minimum with 32MB of RAM. While this is true for Windows, have you ever tried or used MPXPLAY for DOS?

It is really easy to set up, runs under plain DOS and needs a minimum of only a Pentium 75MHz machine with only 4MB of RAM!

It works brilliantly, is very stable, and we use it here for radio automation and PA automation, as it never falls over like Windows. Even on the odd occasion when it does (due to power-cut or other), it is re-booted and up and playing again within 10-15 seconds from re-boot. This is recovery time that Windows can only dream of.

MPXplay also has LCD driver support for LPT1 coded into it and there is a TSR program you can download, that allows MPXplay to drive any LCD up to an impressive 40 x 4 module, with completely customisable display layouts and multiple screens.

If you have a standard VGA screen, MPXplay is FULL-SCREEN with spectrum analyser and cross-fading, random play and heaps of other features built in. Best of all: It is FREEWARE! Point your browser to: <http://www.geocities.com/mpxplay/

Here, you will find the latest version and links. My setup uses this program to play MP3 music on a local radio station and it has gone for the last three weeks with no crashes (this is 24-hour playing) – another thing that Windows can only dream of, especially with a P75 and 4MB of RAM.

Setup is SO easy: simply run the HDD install software (I used a 20GB Seagate with ON-TRACK DDO software) to bypass any BIOS restrictions on HDD size, then boot from a Win95b or 98SE boot disk and SYS the new HDD. This will allow the drive to run using a FAT32 DOS filesystem (actually DOS 7 from Win95b etc). That done, you can access all 20GB or more of HDD space as one chunk (partition) and simply install MPXplay and all your music.

Graeme Rixon,
via email.

Comment: thanks Graeme. The DOS approach sounds attractive.

Macrovision solution

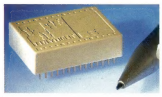
I have a Macrovision solution that is so simple I am surprised no one else has thought of it. What you need is a PC with a capture card and a TV-OUT video card. What I use is a Prolink Play TV Pro Video capture kit and a TNT2 Video card with TV-OUT. The capture card supports watching TV in full-screen mode on the computer.

What I do is Play video 1 onto the PC and have my capture program at full-screen and have the TV-OUT card going to video 2. This not only avoids the Macrovision but removes it totally from the copy.

There is also no generation loss because the video stream re-encoded in the computer so you have a copy of the same quality as the original. I have tried this on about 15 Macrovision-protected tapes without a problem.

Lindsay Harvey,
via email.

The Tiger comes to Australia

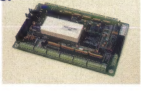


The BASIC, Tiny and Economy Tigers are sold in Australia by JED, with W98/NT software and local single board systems.

Tigers are modules running true compiled multi-tasking BASIC in a 16/32 bit core, with typically 512K bytes of FLASH (program and data) memory and 32/128/512 K bytes of RAM. The **Tiny Tiger** has four, 10 bit analog ins, lots of digital I/O, two UARTs, SPI, I²C, 1-wire, RTC and has low cost W98/NT compile, debug and download software.

JED makes four Australian boards with up to 64 screw-terminal I/O, more UARTs & LCD/keyboard support. See JED's www site for data.

TIG505 Single Board Computer



The TIG505 is an Australian SBC using the TCN1/4 or TCN4/4 Tiger processor with 512K FLASH and 128/512K RAM. It has 50 I/O lines, 2 RS232/485 ports, SPI, RTC, LCD, 4 ADC, 4 (opt.) DAC, and DataFLASH memory expansion. Various Xilinx FPGAs can add 3x 32bit quad shaft encoder, X10 or counter/timer functions. See www site for data.

$330 PC-PROM Programmer

This programmer plugs into a PC printer port and reads, writes and edits any 28 or 32-pin PROM. Comes with plug-pack, cable and software.

Also available is a multi-PROM UV eraser with timer, and a 32/32 PLCC converter.

JED Microprocessors Pty Ltd
173 Boronia Rd, Boronia, Victoria, 3155
Ph. 03 9762 3588, Fax 03 9762 5499
www.jedmicro.com.au

You will no longer have direct control over your car's brakes

The recently released Mercedes SL-Class is fitted with Sensotronic Brake Control as standard – the first car in the world with the system. (DaimlerChrysler).

Electronic Braking Control in Cars

Braking systems in cars are set for big changes with this new Bosch system which has just been introduced to Mercedes Benz cars. Incorporating the best of ABS, ESP and traction control, the new braking system will even dry out the brakes after they have been wet and enable a smooth stop every time, without any dip in the car's bonnet as you come to a complete stop.

By JULIAN EDGAR

APART FROM THE introduction of ABS (anti-skid braking systems), braking systems in cars have changed little in over 50 years. As has been the case throughout this last half-century, all current systems use an hydraulic master cylinder which applies pressure in proportion to force on the brake pedal. The pressure in the brake lines causes movement of the pistons in the slave cylinders located in each wheel calliper, in turn applying the brake pads to the discs (or shoes to the drums, in older systems).

A vacuum brake booster is also fitted to all cars to reduce the force required on the brake pedal. And ABS? – it allows the automatic modulation of fluid pressure in the slave cylinders of individual wheel brakes, to prevent wheel lock-up.

Now, in the Bosch Sensotronic Brake Control (SBC) system, the control system becomes electronic. Further, the control logic is quite different to a traditional braking system, as SBC integrates a variety of other car control systems into the one architecture.

SBC represents a revolution in automotive braking – and it's just been released in the SL-Class Mercedes production model.

Integrating systems

SBC needs to be considered not as a standalone braking system but in the context of a number of other car driveline control systems.

ABS (anti-skid braking) is now common on modern cars but ESP (electronic stability program) is much rarer. ESP uses the input of a vehicle yaw sensor, wheel speed sensors and a steering angle sensor to determine whether the vehicle is following the path requested by the driver. If the electronic system detects that, for example, the car is running wide in the corner (ie, it is under-steering), the ESP system will brake the inside rear wheel, pulling the nose of the car around.

Similar one-wheel braking strategies can be used to control oversteer (the rear of the car running wide).

It is important to note that ESP is not the same as traction control. Traction control limits the spinning of the powered wheels, usually by reducing engine torque (although also occasionally by braking the slipping wheel). On the other hand, ESP can work very effectively when no throttle at all is being applied. For example, a driver who enters a corner too fast, then realises his error and lifts the throttle sharply, can cause a power-off oversteer slide – the car attempting to spin.

The components of a Sensotronic Brake Control system include wheel speed sensors, a steering angle sensor, acceleration sensor, electronic control unit and hydraulic control unit. (DaimlerChrysler).

In this situation, ESP can brake the outside front wheel, preventing the incipient spin occurring. In the same situation, a traction control system is powerless.

Another car system that is relevant to the braking system is Adaptive Cruise Control. This uses radar to maintain a preset distance to the car in front – an approach that needs to have control over the brakes in addition to being able to modulate the throttle.

Finally, many luxury cars use Brake Assist technology, where if the system detects that the driver has braked very forcefully, the brakes are applied at maximum power – even if the driver reduces braking pressure a little. This approach was developed when testing of drivers in real on-road situations showed that when confronted

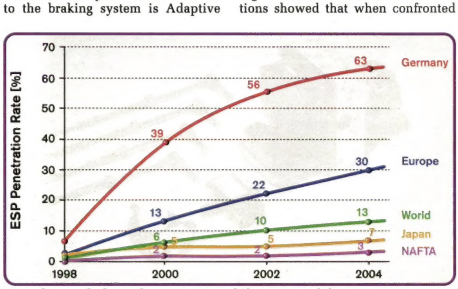


Fig.1: this graph shows the penetration of Electronic Stability Program systems in various automotive markets. Bosch has produced over three million ESP systems and expects Sensotronic braking to follow a similar growth pattern over the next five years. (Bosch).

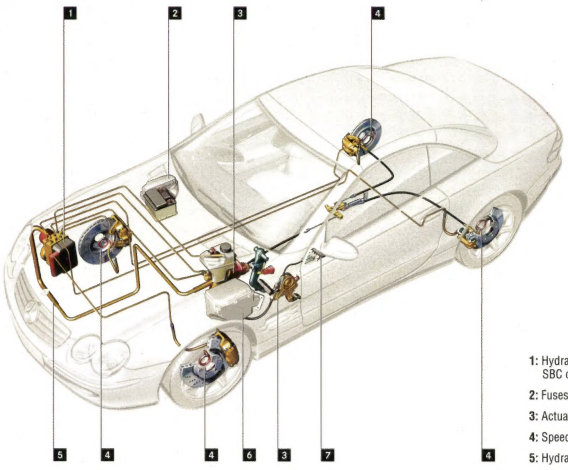


Fig.2: the distribution of the Sensotronic Brake Control components in the SL Mercedes. (DaimlerChrysler)

with the need for an emergency stop, many simply didn't push hard enough, and didn't keep pushing hard enough, on the pedal.

So anti-lock braking, brake assist, electronic stability program, traction control and adaptive cruise control are, to a greater or lesser extent, currently standalone systems that could be better integrated with the braking system.

And as you may have now guessed, SBC does just that.

SBC architecture

SBC still uses hydraulic fluid, a master cylinder and wheel slave cylinders – electromagnetic operation of the brake pads does not occur. While technically, electromagnetic actuation of brake pads is feasible (and is currently used in electrically-braked trailers), the retention of an hydraulic system allows for fail-safe operation of the front brakes in the case of electronic failure.

In SBC, fluid pressure is generated not by the driver's foot movement and the brake booster operation but by a piston pump driven by an electric motor. This supplies brake fluid at a pressure of 140-160 Bar (2000 - 2350 psi) to a high-pressure gas diaphragm accumulator. This stored pressure is sufficient for several braking events, allowing full braking pressure to be applied a number of times, even when the engine is switched off.

When the brakes are activated – either by the driver, Electronic Stability Program, Traction Control or Intelligent Cruise Control – the electronic control unit calculates the desired target brake pressures on a wheel-by-wheel basis. Remember, during ESP operation it's likely that only single wheels will be braked – although of course in normal, straight-line, low deceleration braking events, all four wheels are retarded.

The interface with the driver is by means of the brake hydraulic actuation unit. This comprises a special tandem master cylinder which uses a simulator to provide normal pedal feedback. However, the important part of this mechanism is the pedal travel sensor, which determines both how fast and over what distance the brake pedal is being moved. During normal braking, the brake pedal is completely disconnected from the hydraulics of the system – it is simply an input into the electronic control unit to indicate the degree of braking requested by the driver.

Only if a major fault or power failure occurs does the brake pedal actuate an hydraulic circuit.

In addition to the brake pedal travel sensor, the electronic control unit also receives data on steering wheel angle,

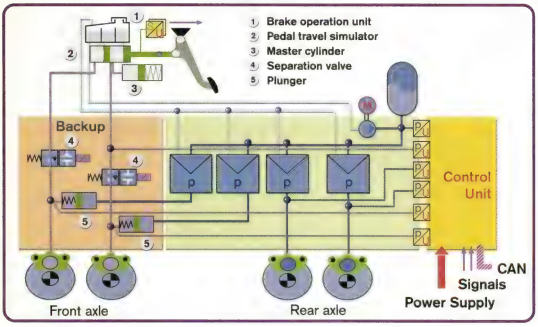


Fig.3: the Sensotronic Brake Control system. An electric motor operates a piston pump that pressurises an accumulator. Fluid from the accumulator then operates individual brake cylinders as required. Except in emergency fail-safe operation, the brake pedal is not connected to the hydraulic system. (Bosch).

individual wheel speeds, the selected gear and lateral (ie, sideways) acceleration. The latter is used to detect whether the car is cornering – if it is, then the braking bias is adjusted laterally, with the outside wheels braked more heavily than those on the inside of the corner.

This reduces the likelihood of ESP needing to intervene during emergency braking manoeuvres.

Advantages

Bosch, the inventor of the system, believes that SBC will penetrate the luxury car market quickly, then filter down to cheaper cars in the way that ABS and more recently, ESP has. But what are the advantages to the driver of such a braking system?

Says Gunther Plapp, Vice President of Bosch's ABS and Brakes Division, "The crucial performance feature of the electro-hydraulic brake SBC is that it raises braking comfort".

A number of comfort and convenience features can be integrated into the system. These include:

- The 'Soft-Stop-Function', which provides for a soft and smooth stop during normal braking.
- A 'Traffic Jam Assistant', which brakes the vehicle with pre-defined deceleration when the driver removes his or her foot from the accelerator pedal. On the Mercedes SL-Class, this mode is engaged by using the cruise control stalk when the car is stationary.
- The 'Drive-Away Assistant', which prevents the car rolling backward on a hill and simplifies the drive-away process. The function is activated by quickly and firmly pressing down the brake pedal when the car is stationary. The brake effect is automatically cancelled the next time pressure is applied to the accelerator pedal.
- 'ACC Stop & Go' is an upgrade of the adaptive cruise control function that is applicable for stop-and-go traffic or city driving. If the vehicle ahead stops, SBC brakes the vehicle to a standstill. If the driver ahead accelerates, the car drives away automatically and follows.

Safety features of SBC include:

- 'Dry Brake Function', where on wet

The Sensotronic Brake Control master cylinder lacks a brake booster. In addition, the 'hydraulic fluid displacement' function of the brake pedal occurs only in an emergency, retarding just the front wheels. (Bosch).

Fig.4: Sensotronic Brake Control allows the braking force to be altered laterally, giving better stability when braking heavily while cornering. This reduces the likelihood of Stability Control needing to operate in these situations. (DaimlerChrysler).

roads the SBC carries out regular short and weak brake applications to wipe the water film off the brake discs. Switching on the windscreen wipers activates this function.

- Reduced stopping distances. This is possible because the system can be configured to pre-fill the brake circuits if a sudden lift of the accelerator pedal is detected.
- The vibration of the brake pedal that normally occurs during ABS operation is not present with SBC. DaimlerChrysler driving simulator research shows that this absence is not just a comfort advantage but also has safety implications – almost two-thirds of tested people are startled when ABS pedal pulsation occurs. A proportion of these people do not maintain appropriate brake pedal pressure when this happens and some even take their foot off the pedal!
- Reduced requirement for Stability Control, because braking force can be varied laterally during cornering.

The future

SBC is currently available only on one very expensive car – the Mercedes SL. However by 2005, Bosch expects that lower cost SBC systems will be available for mass fitting to a wide range of vehicles. **SC**

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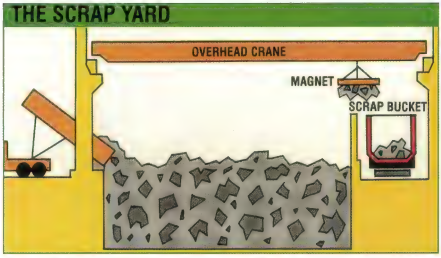
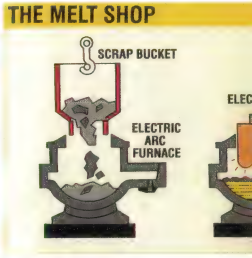


STEP ONE
Scrap steel is delivered by truck and tipped into the mill's scrap pit which has a capacity of 18,000 tonnes – carefully divided into four grades held in separate bays. That's enough to feed the mill for two weeks.

STEP TWO
According to the demands of the furnace production schedule, the various grades are loaded into scrap buckets for transfer by rail trolley into the melt shop.



STEP THREE
In the melt shop, a crane lifts the scrap bucket and empties its 80 tonne load into the opened arc furnace. The melting and refining stages are conducted at 1600°C.
As the scrap is melted by the electric arcs, fluxes are added to form a slag on top of the molten steel. Oxygen is then injected by lance through the slag, into the molten steel. The resulting chemical reactions cause the slag to absorb most of the impurities from the steel.
Those impurities that are not transferred to the slag are exhausted as fumes for cooling and collecting via the mill's fabric filter bag system.

These days, a significant proportion of the steel produced in the USA and Australia comes from Mini Mills. These use an electric arc furnace to melt down scrap steel, thereby saving a considerable amount of energy which would otherwise be required to make steel from iron ore. In this article, we will look at what constitutes a mini mill and visit the mini mill at Rooty Hill in Sydney.

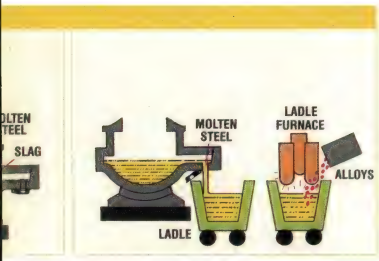
By BOB YOUNG

Steel Mini Mills: a recycling success story

THERE ARE SEVERAL mini mills in Australia and quite a few in the USA and they produce a considerable amount of steel from what is essentially quite a small plant. So what is a mini mill?

A mini mill is a steel production facility that uses an electric arc furnace to melt the scrap steel. In contrast, the traditional Integrated Steel mill has blast furnaces or basic oxygen furnaces using iron ore and coke as the basic ingredients with some scrap thrown in. Although some integrated mills have electric arc furnaces for specific purposes, the arc furnace is the key component of a mini mill.

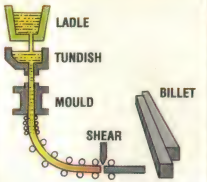
Over the past 20 to 30 years, there has been substantial growth in mini mills. In 1970, mini mills accounted for less than 10% of US steel production. These early mills typically produced between 100,000 and 300,000 tonnes per annum, with the number of grades of steel and product types kept to a minimum. In 2001, mini mills produced nearly half of the steel



STEP FOUR

When the steel has reached the required temperature and chemistry it is tapped into a ladle for transfer to the ladle furnace area.
In the ladle furnace there is more refining to be done – this time through selective addition of alloys. In the ladle, the temperature of the molten steel is increased and maintained by electric arcs mounted in the ladle furnace cover.

THE CAST SHOP



STEP FIVE

When the required alloys have been added and exact specifications have been reached, the molten steel is taken to the cast shop where it is poured into a tundish from where it flows into a series of water-cooled moulds to form continuously cast billets.
The 127mm square partially solidified billet strands are further cooled by direct water spray in a secondary cooling zone. While they are still hot, however, they are cut into 12-metre lengths by automatic hydraulic shears.
The billets are then air-cooled before being carried by overhead cranes fitted with electromagnets into the outdoor billet stacking yard.

shipped by United States mills. Nor is it stopping there. Mini mills are no longer mini, with production capacities now approaching 1,000,000 - 2,500,000 tonnes per annum while still using a single but now quite large arc furnace. In addition, the list of grades of steel produced and product types has increased considerably.

North American carbon steel minimills continue to be among the most competitive steel makers in the world. Some idea of the growth in productivity can be obtained from the following figures. In 1983, integrated mills were producing about 200 tonnes of steel per employee, rising to approximately 700 tonnes in 1996. The latest mini mills are claiming 4,000 tonnes per employee.

Although arc furnaces use large amounts of electric energy to heat the steel scrap, there is a significant saving on raw materials. For every tonne of steel recycled, there are 1.25 tonnes of iron ore, 0.5 tonne of coal and about 20kg of limestone saved.

As the name would indicate, mini mills have a relatively low steel production capacity when compared with integrated steel mills but they can be accommodated comfortably on just a few hectares. Because they do not need to be located near a railway or water transportation facilities, mini mills have a much wider range of suitable geographic locations.

The factors driving mini mill location are an adequate supply of electricity, scrap availability and a local market for products.

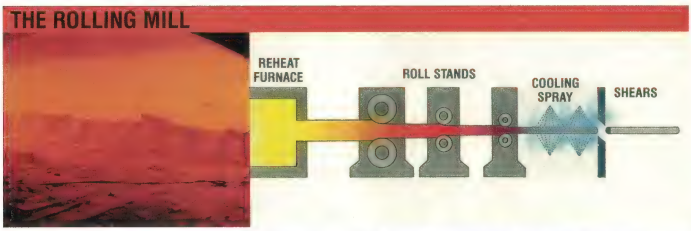
While mini mills are more specialised in the types and quality of the steel produced, the wastes are similar to those from iron and steel making. The major difference in mini mill waste is increased concentrations of toxic metals in dust, sludge and slag, due to the scrap metal used as the input. Stainless steel scrap for example, is high in nickel and chromium, while other steel scrap may often have a coating of zinc, tin, nickel, lead or chromium.

Certain scrap may need to be chemically or physically treated before entering the arc furnace to remove its coating (eg, de-galvanising) before being processed into new steel and it is here that the mini mill metallurgist has to exercise some of his magic. To take an unknown mix of scrap steel and finally produce a certifiable grade of new steel requires considerable expertise and yet it is all in a day's work for the mini mill metallurgist.

Finally, as most mini mills are located in large cities, great care is exercised in maintaining the required environmental controls. Indeed, environmental factors dominate the design of any modern mini mill.

Electric arc furnaces

The arc furnace has been in use for



STEP SIX

Billets are fed into a natural gas-fired furnace where they are reheated to rolling temperature of about 1150°C. The billets are fed through a series of rolling mill stands where they are reduced and formed into various sections and sizes, such as angles, reinforcing bars and wire rod. The rod and bar products produced in the mill are cooled by water sprays and air before being sheared to customer specified lengths.

STEP SEVEN

After shearing or coiling, products are transferred to the mill's finishing area for straightening, bundling, strapping and dispatch to customers.

nearly 100 years as a method of making steel. Originally confined to small (several tonne) furnaces for the production of highly specialised steels, recent developments have seen the arc furnace growing in size and popularity as technical problems have been overcome and reliable sources of cheap electricity have become widespread.

In the last 15 years or so, the arc furnace has undergone something of a renaissance as technical innovations have led to very significant improvements in productivity, steel quality and operating cost. These developments have proceeded to the point where the arc furnace is now the preferred, low capital, flexible route for the production of a significant proportion of flat products and almost exclusively, long products.

The modern electric arc furnace consists of a refractory lined steel shell or hearth that holds the scrap charge while it is being melted and retains the liquid steel until it is ready to tap. The walls above the liquid steel level are typically water-cooled, replaceable copper panels. The furnace has a water-cooled roof that can be swung aside to allow for scrap recharging.

In most cases, loading of the furnace is carried out via overhead clamshell buckets or baskets. All types of scrap and scrap substitutes can be added in this manner. Sometimes charge carbon and fluxes (lime and dolomite) are also added in this manner.

The preferred method of adding smaller input materials is via a conveyer belt, loading into the "fifth" hole in the furnace roof. This is known as continuous charging. The number of buckets required to reach the specified tap weight will be determined by the scrap charge density.

Arc furnaces can be either AC (three electrodes, each with its own phases) or DC (single or twin electrode). In an AC furnace, the roof has at least five openings, one for each of the three electrodes, one for fume evacuation and the abovementioned "fifth" hole.

Electric arc furnace

In an AC furnace, the current path is from the electrode tip to the bath and back to the next electrode in the phase rotation. In a DC furnace, the current passes from the electrode through the bath to a return electrode in the furnace hearth.

The electrodes are made of graphite manufactured to have special properties of conductivity combined with high strength at high temperatures. The electrodes are consumed in the process and need to be continually replaced. This is achieved by "slipping" or lowering the electrode through the holding arm into the bath and adding a new section to the top. This is done by screwing electrode sections together.

Electrical power is supplied from a substation, then to a step-down transformer. The furnace also has its own transformer that serves to alter the furnace electrode voltage. These voltage "taps" are usually selected automatically but they may also be ad-

justed manually by the furnace operator. The electrode voltage determines the arc length and therefore the power applied to melt the steel.

As conditions inside the furnace are constantly changing, it is necessary to continually reposition the electrodes to maintain the desired arc current and power setting. This is normally achieved by constantly measuring the impedance (voltage divided by current) and feeding this back to a control system that will raise or lower the electrode arms as the conditions inside the furnace change.

Oxygen is used to assist in refining the steel by burning off impurities such as phosphorus. A lime-rich slag is used to collect this and other unwanted elements and provide a base material to be foamed by the evolution of carbon monoxide and carbon dioxide gases. This foamy slag helps improve energy efficiency by preventing unwanted radiation of the unshielded arc to the furnace roof. The foaming action causes the slag to be continuously flushed from the furnace up until tap time.

The molten slag also helps in suppressing the considerable amount of noise produced by the electric arcs.

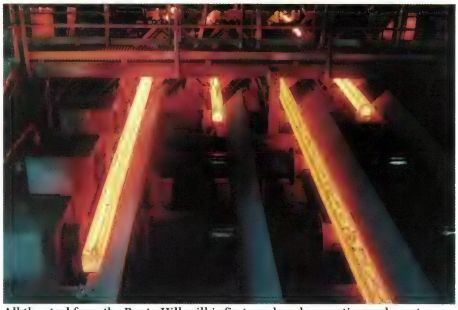
When the appropriate steel chemistry and temperature have been achieved, the steel is tapped either through a spout or a submerged taphole, into a ladle and then on to a ladle furnace for secondary treatment.

Furnaces manufactured by EMCI for example may be bottom tap design or conventional design with standard or current conducting electrode arms. EMCI's electric arc furnaces also feature hydraulic circuitry that allows for rapid electrode travel and fast back tilt to minimise slag carry-over.

Rooty Hill's mini mill

To illustrate the operation of a typical mini mill, we now look at the One Steel plant at Rooty Hill in Sydney, NSW. This is quite a small facility and yet the very first thing that stands out is the small size of the actual Melt Shop and electric arc furnace itself in comparison to the overall size of the whole facility.

The 60-tonne electric arc furnace has been coaxed by an ingenious and industrious staff into taking 80 tonnes of scrap in a single feeding. It is this "small" furnace, working on a continuous basis, that produces the vast stacks of steel in the Rooty Hill mill; some 500,000 tonnes per annum, 200,000 tonnes of which is sold as bar stock. Here then is a very efficient operation by any standard.

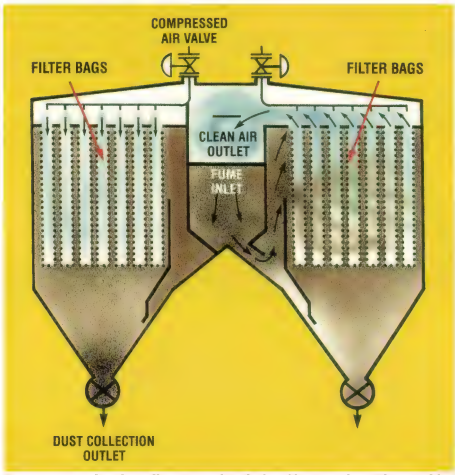


All the steel from the Rooty Hill mill is first produced as continuously cast billets such as these emerging from the tundish via water-cooled moulds. The extreme heat rising from these billets has to be experienced to be believed yet it is a pale shadow of that from the electric arc furnace.

The billets are later reheated prior to being fed to the rolling mill to produce a wide variety of sections such as angles, reinforcing bars (rebar) for concrete, round bars, flats, fencing wire and so on.

The furnace consumes large amounts of electricity, the actual rating being 62MVA (equivalent to 62 megawatts). The magnetic fields surrounding the furnace is so strong that the video monitors in the nearby control room flicker continuously in spite of serious efforts to shield them. How the staff manage to watch these flickering images continuously defies comprehension. We assume that the computer monitors will shortly be upgraded to LCD monitors which would cure the problem completely!

To enter the melt shop and confront the electric arc furnace in full song is to finally come face to face with Dante's Inferno. Housed in a towering, dark, windowless building, blackened



Fumes generated in the mill are treated in the bag filtration plant. This acts like a gigantic vacuum cleaner to remove dust and particles before release to the atmosphere. The righthand bag is operational while the other is on standby.

internally by years of fumes and dust, the furnace presents an eerie sight. Crouching in one corner and tied to the Melt Shop building by a staggering array of cables of all sizes – cables that soar loftily up into the inky blackness of the dimly lit, almost invisible ceiling – the furnace resembles some prehistoric fire-breathing monster chained down to prevent its escape.

The monster within

To confront this monster, the visitor is given earplugs, glasses and a woollen jacket. Roaring and spitting and emitting an intense light so bright that it can only be viewed through special glasses, and heat that is fearsome to the extreme, one is immediately struck with the thought that those who care for this monster are special people. To office workers who confront nothing more daunting in their working day than a hot cup of coffee, here is a different world indeed.

Control of the furnace is a delicate operation. To begin, the scrap steel input is carefully prepared to stringent quality standards by suppliers. Composed largely of old car bodies, washing machines, fridges and the like, combined with structural steel from demolition sites, waste and offcuts left over from other steel mills, the input is a disparate mix. For example, car bodies and white goods (fridges, etc) will have been shredded to remove all paint and plating so that they are completely unrecognisable.

From this raw material, the metallurgists at the mill will eventually produce certified grades of steel used in such industries as construction, farming and transport. The mix in the electric arc furnace must therefore be continuously monitored and adjusted by the addition of other raw materials such as burnt limestone and dolomite, carbon, ferro alloys, oxygen and nitrogen.

Feeding the electric arc furnace continuously with a stream of scrap that may on occasions still contain an unknown quantity of impurities, in spite of careful sorting, can lead to eruptions that may spit molten steel across the melt-shop floor. Looking after the furnace is certainly not a job for the fainthearted!

The main steps

There are five major steps in the transformation of scrap into graded steel at the Rooty Hill steel mill.

(1) The carefully graded scrap is delivered by truck to the mill's scrap pit which measures 100 x 23 x 6 metres deep. It is capable of holding up to 18,000 tonnes, enough to feed the furnace for about three weeks.

(2) Depending upon the demands of the furnace production schedule, the various grades are loaded by electromagnetic crane into scrap buckets for transfer into the melt shop.

Interestingly, all the electromagnetic cranes in the plant have battery backup, for safe depositing of loads in case of power failure.

(3) In the melt shop, a crane lifts the scrap bucket and empties its load into the opened arc furnace. The furnace capacity is 80 tonnes and the number of buckets required to load the furnace depends on the scrap density. The furnace is manufactured by Danieli, Italy. Bath diameter is 5.5 metres and the tap weight is 75 tonnes. By the way, the electrode diameter is 550mm.

The melting and refining stages are conducted at 1600°C. As the scrap is melted by the electric arcs, fluxes are added to form a slag on top of the molten steel. Oxygen is then injected by a lance through the slag, into the molten steel.

The resulting chemical reaction causes the slag to absorb most of the impurities from the steel. Those impurities that are not trapped in the slag are vented for cooling and collecting via the mill's fabric filter bag system.

The time from charging to finish of a batch is 44 minutes and tap-to-tap time is 56 minutes.

(4) When the steel has reached the required temperature and chemistry, it is tapped into a ladle for transfer to the ladle furnace area. The ladle furnace is again manufactured by Danieli and is a 12MVA, bottom-stirring furnace featuring 350mm electrodes. Power consumption is 15kWh/liquid tonne.

(5) In the ladle furnace there is more

refining to be done, through selective addition of alloys. When the required alloys have been added and exact specifications have been reached, the molten steel is taken to the cast shop where it is poured into a tundish from where it flows into a series of water-cooled moulds to form continuously cast billets.

The continuous caster is a Danieli, four-strand billet caster with either 121mm or 127mm sections. The extrusion rate of the billets varies between 2.9 - 3.1 metres per second, the maximum sequence length being 36 hours. The square partially solidified billet strands are further cooled by direct water spray in a secondary cooling zone. While they are still hot however, they are cut into 12-metre lengths by automatic hydraulic shears. A fully laden furnace will produce approximately 88 billets.

The billets are then air-cooled before being carried by overhead cranes fitted with electromagnets into the outdoor billet-stacking yard. It is interesting to note that steel loses its magnetic properties above 600°C so cooling must be well under way before the steel billets can be handled with electromagnets.

Rolling into finished stock

As stated earlier, of the approximately 500,000 tonnes of steel billets produced at the Rooty Hill mill, approximately 200,000 tonnes are sold as raw billets to other steel mills. The remainder is processed into lengths of various shapes and sizes.

The rolling process begins with the billets being reheated in a natural gas-fired recuperative walking hearth furnace where they are raised to the rolling temperature of about 1150°C. Billets are then fed through a 16-stand 800kW rolling mill with a throughput of 270,000 tonnes per annum.

Here they are reduced and formed into such shapes as reinforcing bar for the building industry, angles and flats for construction and transport and wire rod for the fastener and wire industries. The rod and bar products produced in the rolling mill are cooled by water sprays and air before being sheared to customer specified lengths. Shearing is carried out on-the-fly by a swinging-arm guillotine, the finished stock moving through the shears at 13 metres per second.

After shearing or coiling, products are then transferred to the mill's finishing area for straightening, bundling, strapping, identification and dispatch to customers in the Sydney area. The plant's warehouse area can accommodate up to 18,000 tonnes of finished product.

Environmental considerations

As the mill is located in the heart of a Sydney residential suburb, housing the electric arc furnace obviously required considerable care, as indeed did the whole mill. The seven hectares of mill buildings are located in the centre of a 27-hectare landscaped area.

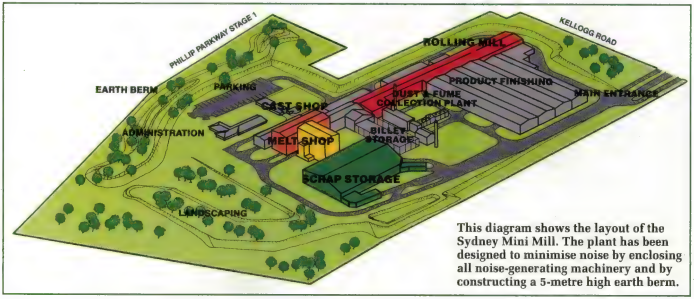
Soundproofing the Melt Shop and all noise generating plant required the use of 320mm thick, sound-absorbing precast concrete wall panels. Soundproofing is further enhanced by surrounding the entire plant with a 5-metre high solid earth berm, created from some 63,000 cubic metres of topsoil material.

An air-monitoring station near the site incorporates a high volume sampler and dust fallout gauge, as well as wind-direction and wind-velocity meters. During mill operation, fumes generated are removed from the building and filtered through thousands of filter bags housed in the mill's baghouse. Designed to handle a total volume of 730,000 normal cubic metres of fumes per hour, the bags act like a gigantic vacuum cleaner to remove dust and particles to levels well below the limits set by the NSW Clean Air Act.

The mini mill also recycles all of its processed water before it passes to the sewer, to standards set by the Water Board. Site runoff is strictly controlled via a separate drainage system feeding into settling ponds where sediment collects before clear water runs into nearby Eastern Creek.

So there it is. Rooty Hill is one of several mini steel mills in Australia and is relatively small by the standards of such mills overseas but it still manages to produce half a million tonnes of steel per annum. **SC**

Acknowledgments: our thanks to John Prestidge and Vince Ivancic, One Steel, Rooty Hill, Sydney for their kind assistance in preparing this article and for a conducted tour of the One Steel mill. All photos and diagrams courtesy BHP Steel.



This diagram shows the layout of the Sydney Mini Mill. The plant has been designed to minimise noise by enclosing all noise-generating machinery and by constructing a 5-metre high earth berm.

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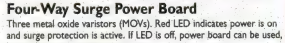

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K 3019

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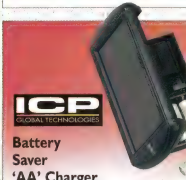

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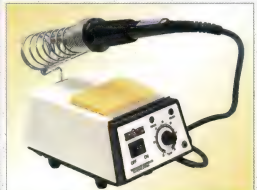

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DICK SMITH ELECTRONICS

That's where you go!

This versatile infrared (IR) remote control receiver boasts no less than 10 channels, each of which can be independently set for momentary or toggle operation. It works with most commercial IR remote transmitters and is a snack to build and use.

10-Channel IR Remote Control Receiver

By JOHN CLARKE

Where would we be without our infrared remote controls? Stuck back in the dinosaur era, that's where. IR remote controls are now built into lots of appliances, ranging from TV sets and VCRs to audio equipment, robots and lights.

This relatively simple design makes it easy for you to add infrared remote control to your latest project or to existing equipment.

What's more, it can control up to 10 different functions, which should be more than enough for most applications (usually, you'll only need one or two channels). Each output uses an open-collector transistor and this can be used to switch a relay or even to directly switch other 12V equipment.

The outputs can also be used to drive LEDs via current limiting resistors or to drive optocouplers (eg, to provide isolation from high-voltage circuitry). Heavy current items such as motors and light bulbs will have to be driven by relays. We've made the job easy for you by including diagrams that show all the various options – see Figs.5(a)-5(d).

Commercial remote

As already indicated, the 10-channel remote receiver is operated using a commercial handheld remote which can also be used to control your TV, VCR or satellite receiver. Using a commercial IR transmitter vastly simplifies the construction and you also get a professional looking controller as well.

Operation is simple – just press one of the 0-9 buttons on the transmitter to control the 0-9 outputs on the receiver. A momentary output stays on for as long as its transmitter button is held down, while a toggle output alternates between ON and OFF on each subsequent press of the button. An acknowledge LED flashes whenever an IR signal is being received, while 10 more LEDs are used to indicate the status of the outputs.

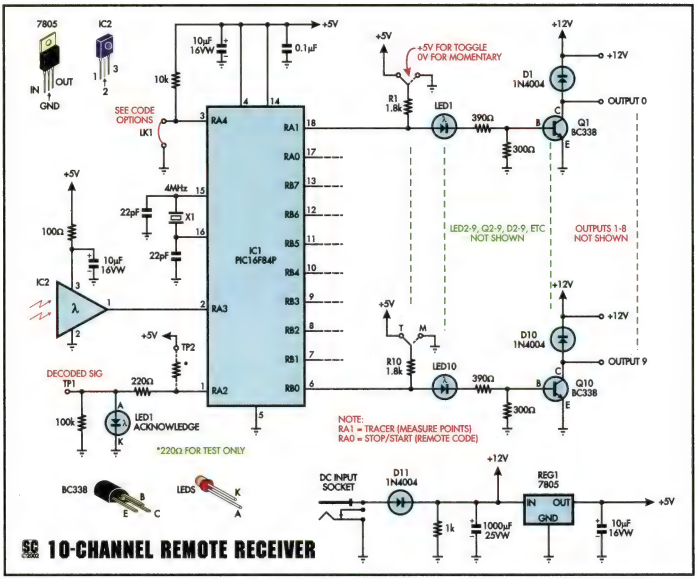
There, we told you it was simple to operate!

All the parts for the circuit are mounted on a small PC board and this can either be housed in a separate plastic box or built right into existing equipment. The operational range is up to about 12 metres.

Circuit details

Refer now to Fig.1 for the circuit details.

As shown, it's based on a preprogrammed PIC16F84 microcontroller (IC1). What? – you don't like micro-



SC 10-CHANNEL REMOTE RECEIVER

Fig.1: IC2 is the infrared receiver – it picks up the pulses from the transmitter and applies a demodulated signal to pin 2 of PIC microcontroller IC1. IC1 decodes the signal on its pin 2 input and switches the appropriate output.

controllers? Awwww – c'mon; it's a beautiful microcontroller and it greatly simplifies the circuit design because all the hard work is done by the software that's programmed into the device.

You don't have to worry about any of this, of course, because you just buy the preprogrammed device and "plug" it in – just like any other IC.

Apart from the PIC, there's just one other IC, a 3-terminal regulator (REG1), 10-transistors (Q1-Q10), 11 diodes, a crystal and a few resistors and capacitors. Let's see how it all works.

IC2 is an infrared receiver which amplifies, filters and demodulates the code supplied by the transmitter. The top trace in Fig.3 shows the modulated signal from the hand-held transmitter, while the lower trace is the demodulated signal at the output of IC2. The modulation is at about 36kHz and represents a high level (low levels are represented by no modulation).

Note that the output of IC2 is inverted compared to the transmitted code.

The remote control coding that we are using is called the "Philips RC5" code. It comprises 14-bits of information, including two start bits, a toggle bit, five address bits and six command bits.

The two start bits are transmitted first (makes sense, doesn't it?), followed by the toggle bit. This toggle bit changes each time the same button is pressed on the transmitter. If the button is simply held down, the transmission repeats at 113.778ms intervals and the toggle bit remains either high or low. The state of the toggle bit

MAIN FEATURES

- Uses a commercial handheld IR remote
- 10 separate outputs
- Outputs can be independently set for momentary or toggle operation
- Acknowledge LED
- LED indicator on each channel
- Transistor output for relay connection
- Operates on two different remote codes
- 12V DC operation

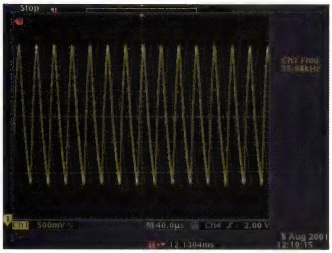


Fig.2: the modulating waveform – this operates at about 36kHz and is the frequency at which the infrared transmitting LED in the remote is switched on and off

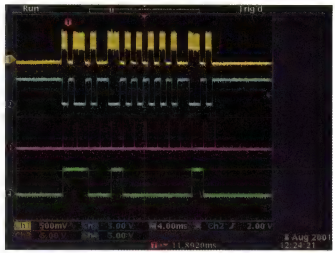


Fig.3: the top waveform (channel 1) is the signal applied to IC2 before demodulation, while channel 2 shows the output of IC2 after the 36kHz signal has been removed.

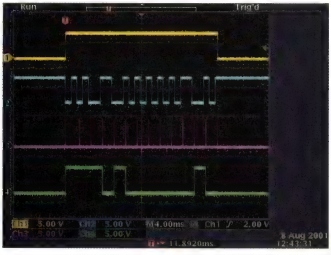


Fig.4: the top waveform here (channel 1) shows the stop/start signal on pin 17 of IC1. The bottom three waveforms (channels 2-4) are the same as in Fig.3.

allows the receiver to distinguish between whether a button is being held down continuously or has been pressed more than once.

The address bits are for selecting the type of equipment to be used. For example, address 0 (00000) is for a TV set. Address 1 (00001) is for TV2 or a second TV set. The two addresses we are using are for Satellite 1 and 2 at addresses 8 (01000) and 10 (01010).

The last six bits are the commands and we are using buttons 0, 1, 2, 3, 4, 5, 6, 7, 8 & 9, which have codes 0 (000000), 1 (000001), 2 (000010), 3 (000011), 4 (000100), 5 (000101), 6 (001100), 7 (000111), 8 (001000) and 9 (001001). These codes are transmitted in "bi-phase" format, where a low is a high level falling to a low, while a high is a low rising to a high.

IC1 (the PIC microcontroller) is used to decode the demodulated signal from IC2. It does everything from the remote control decoding to driving the outputs. It also does away with the need for a specialised IC and can be programmed to operate with existing commercial remote controls.

In operation, IC1 monitors its pin 2 input for a remote control signal. When a signal arrives, it detects the start bits and then monitors the demodulated signal at regular intervals to provide the code sequence.

The timing is controlled by dividing down the signal from a 4MHz crystal (X1) to obtain 1.8ms intervals – this is the spacing between each bit in the remote control sequence. The decoded signal appears at pin 1 of IC1 and is used to drive the Acknowledge LED (LED11) via a 220Ω resistor.

IC1 can be forced to display its remote control status by connecting pin 1 to the 5V supply (TP2) via a 220Ω test resistor at power up. This will set pins 18 & 17 to provide a tracer signal and a stop and start level for the code respectively.

The tracer shows when the code level is monitored for each of the 14 bits in the code. When in this mode, the 0 and 1 outputs are prevented from operating normally. Normal operation is restored by switching off the supply for a few seconds, removing the 220Ω test resistor and reapplying power.

The accompanying oscilloscope traces show the remote control operation. Fig.2 shows the modulating waveform – this operates at about 36kHz and is the frequency at which the infrared transmitting LED is switched on and off. The presence of 36kHz modulation gives a high signal level, whereas no modulation represents a low signal.

Fig.3 shows the remote control signals. The top waveform (channel 1) is the signal applied to the infrared detector (IC2) before demodulation. This is a modulated waveform with the 36kHz signal appearing when the signal goes high.

The next waveform down (channel 2) shows the output of IC2 after the 36kHz signal has been removed. Note that this signal is actually inverted compared to the top waveform. The tracer (pin 18 of IC1) is the channel 3 signal and this indicates when the level at IC2's output (pin 1) is monitored by IC1.

The resulting decoded output (which is the satellite-1 code for transmit button 4) is shown in channel 4 (ie, the bottom waveform). This decoded signal is made available at TP1

and, as discussed above, drives the Acknowledge LED.

Fig.4 shows a similar set of traces. However, in this case, the top waveform (channel 1) shows the stop/start signal on pin 17 of IC1. The bottom three waveforms (channels 2-4) are the same as in Fig.3.

The decoded signal is compared with those stored in IC1's memory – ie, the 0-9 button codes for satellite 1 (sat1) or satellite 2 (sat2). The voltage level at pin 3 determines whether a comparison is made against the sat1 or sat2 codes – sat1 codes are used if pin 3 is high, while sat2 codes are used if pin 3 is low.

When the transmitted code matches a satellite code in memory, the respective output of IC1 goes high. For example, if we press button 0 on the transmitter, pin 18 of IC1 will go high if the output is set for momentary operation. Alternatively, it will change from a low to a high or from a high to a low if set for toggle operation.

A momentary output will go low as soon as the button is released. By contrast, a toggle output will remain in its new state (high or low) until the button is pressed again.

Remote trickery

One problem with using the commercial IR transmitter is that the codes are not actually generated by the internal circuitry. Instead, they are stored replicas of the codes programmed into the original equipment remote controls that come with TVs and VCRs, etc. These codes are stored in a memory that allows each code sequence to be continuously replayed over a few seconds. When the end of the memory is reached, the sequence in memory is started over again.

Because it would be rare for a code sequence to finish exactly at the end of the memory and start again at the beginning (and with the correct timing between them), there is often a disjointed flow of code. This presents a problem because it is recognised by the receiver as a different code.

We circumvented that problem by monitoring the toggle bit in the remote control sequence. Remember that this toggle bit only changes state if the button is released and then pressed again. If the button is held down continuously, this bit will not change except at the "end of memory" discontinuity.

So, by programming the PIC to ignore very brief code changes (as indicated by very brief changes to the toggle bit), we can easily "filter" out this discontinuity. As a result, the remote control receiver only responds to genuine inputs to the transmitter.

This means that the outputs remain in the correct state if a button on the transmitter is held down.

By the way, the user is entirely unaware of this filtering and there is no detectable delay. Press a button on the remote transmitter and the receiver responds "instantly".

Momentary or toggle operation is set using a programming resistor on each output (R1-R10). Each resistor can be connected to either the +5V rail for a toggle output or to 0V for momentary operation.

When power is first applied to the circuit, pins 18, 17, 13, 12, 11, 10, 9, 8, 7 & 6 of IC1 are all set as inputs. The microcontroller then checks the voltages applied to these inputs, as set by R1-R10.

If a resistor is connected to the 0V rail, its corresponding input will be read as low for momentary operation. Conversely, if the resistor is connected to the +5V supply rail, the voltage at the input will be about 2.69V. That's because the current flows through the 1.8kΩ resistor, a LED (LED1-LED10) and the associated 390Ω and 300Ω resistors.

The voltage across the LED will be about 1.8V, so the resulting current will be (5 - 1.8)/(390Ω + 300Ω + 1.8kΩ) or 1.285mA. This means that 2.31V appears across the 1.8kΩ resistor and so the input will be at 5 - 2.31 = 2.69V

The circuit works with most pre-programmed IR remote controls – eg, the "Big Shot 3" from Jaycar (Cat. AR-1710) and the "8-In-One" from Altronics (Cat.A-1007).

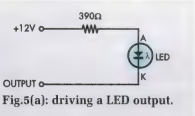


Fig.5(a): driving a LED output.

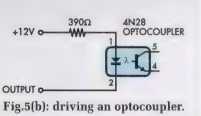


Fig.5(b): driving an optocoupler.

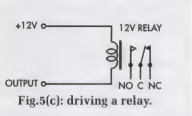


Fig.5(c): driving a relay.

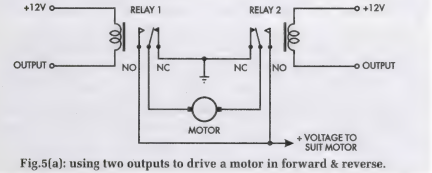


Fig.5(a): using two outputs to drive a motor in forward & reverse.

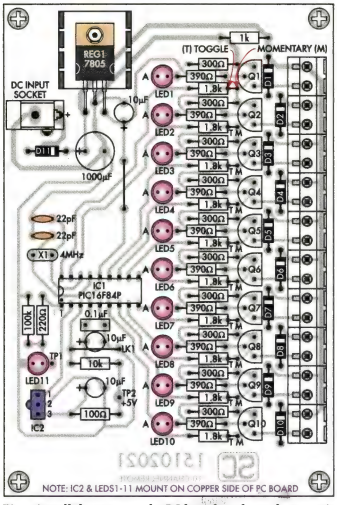


Fig.6: install the parts on the PC board as shown here, noting that the LEDs and the IR receiver (IC2) are mounted on the copper side (see photos). The 1.8kΩ resistors set the individual outputs to toggle (T) or momentary (M) operation, depending on how they are installed – see text.

with respect to the 0V rail. Since a high voltage level only needs to be 2.4V or more, the input will be detected as a high and this selects the toggle mode.

Note that although the current through the 1.8kΩ resistor is sufficient to light the LED, there is insufficient voltage across the 300Ω resistor (about 0.39V) to turn the output transistor on. This prevents the output from momentarily switching on any external devices during power up.

Following power up, the inputs are turned into outputs and drive output transistors Q1-Q10 via LEDs1-10 and 390Ω base resistors. The current through the LEDs is about 6.4mA and each transistor can deliver about 120mA of current. This is sufficient for driving LEDs and 12V relays with more than 100Ω coil resistance.

Note that LEDs1-10 light when ever their respective output transistors are switched on via the remote control. This means that the LEDs on the momentary outputs will light only while their transmitter buttons are pressed, while the LEDs on the toggle outputs will toggle on or off.

Diodes D1-D10 are necessary to protect the output transistors. They quench the inductive spike voltages that can be generated by relay switching.

Power for the circuit is derived from a 12VDC plugpack. Diode D11 protects against reverse polarity connection and the 1000µF capacitor filters the supply. The +12V rail is then used to supply any output loads for transistors Q1-Q10.

The +12V rail is also fed to 3-terminal regulator REG1 to derive a +5V supply. This rail is filtered using a 10µF electrolytic capacitor and supplies IC1 & IC2. Note that IC2 is decoupled from the +5V rail via a 100Ω resistor and 10µF capacitor to filter out any noise on the supply.

Building it

A PC board coded 15102021 and measuring 88 x 130mm accommodates all the parts. Fig.6 shows the assembly details.

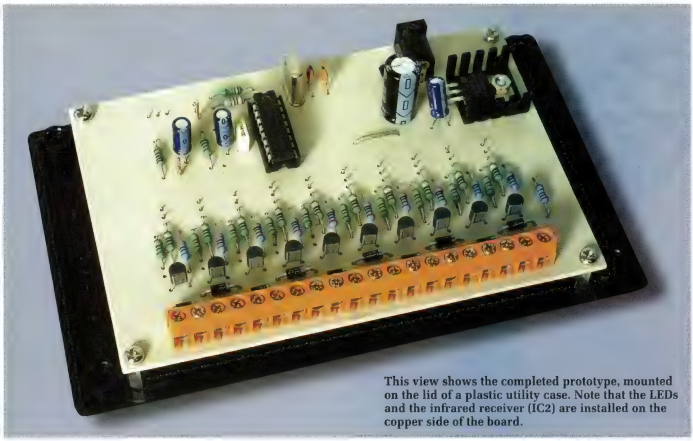
Before installing any parts, carefully inspect the PC board for shorts or breaks in the copper tracks. Check also that the hole sizes are large enough for the components, especially for the screw terminals.

IR CODE OPTIONS

LINK LK1 OUT:	SAT1 (CODE 424)
LINK LK1 IN:	SAT2 (CODE 425)

Table 1: Resistor Colour Codes

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	100kΩ	brown black yellow brown	brown black black orange brown
❑	1	10kΩ	brown black orange brown	brown black black red brown
❑	10	1.8kΩ	brown grey red brown	brown grey black brown brown
❑	1	1kΩ	brown black red brown	brown black black brown brown
❑	10	390Ω	orange white brown brown	orange white black black brown
❑	10	300Ω	orange brown brown brown	orange brown black black brown
❑	2	220Ω	red red brown brown	red red black black brown
❑	1	100Ω	brown black brown brown	brown black black black brown



This view shows the completed prototype, mounted on the lid of a plastic utility case. Note that the LEDs and the infrared receiver (IC2) are installed on the copper side of the board.

Begin the assembly by installing the wire link near LED4 but don't install link LK1. Next, install the resistors in the locations shown. The 1.8kΩ resistors set the outputs to toggle or momentary operation, depending on how they are installed. For toggle operation, connect the resistor lead to the "T" hole. Alternatively, for momentary operation, connect the resistor to the "M" hole.

Table 1 shows the resistor colour codes but it's also a good idea to check them using a digital multimeter – some of the colours can be quite difficult to recognise.

The diodes can go in next, making sure they are all oriented correctly. This done, install a socket for IC1 with pin 1 located as shown on Fig.6.

Similarly, take care to ensure that the electrolytics are oriented correctly when installing the capacitors. Once these are in, install transistors Q1-Q10, followed by the screw terminal blocks (wire entry side facing outwards).

Regulator REG1 is mounted flat against the PC board, along with a small heatsink – see Fig.6. You will need to bend the regulator's leads through 90° so that they pass through their respective holes in the PC board. This done, the regulator and its heatsink are fastened to the board using a 6mm-long M3 screw and nut and the leads are then soldered.

The next step is to install crystal X1, the DC socket and two PC stakes at the TP1 and TP2 positions. That done, you can complete the board assembly by installing the LEDs (LEDs1-11) and IC2 (the infrared receiver).

The LEDs can either be installed on the top of the PC board or on the underside (ie, the copper side), depending on how the assembly is going to be mounted. For the prototype, we installed the LEDs on the copper side – this allowed the completed assembly to be mounted on the lid of a standard plastic case, with the LEDs protruding through the front panel.

About Remote Controls

This 10-Channel Remote Receiver should work with just about any pre-programmed IR remote transmitter that can control a satellite receiver. It's just a matter of programming it to control a Philips satellite receiver (ie, RC5 code) by following the instruction manual.

Similarly, IC2 is also mounted on the copper side of the board. Its leads are then bent through 90° so that the receiving lens aligns with a hole in the front panel next to the Acknowledge LED.

Make sure that the LEDs are correctly oriented when installing them on the PC board. They should be installed with their tops about 14mm above the board surface, while IC2 should be mounted with its lens bezel about 13mm above the board surface.

There's an easy way to mount the LEDs and that's to cut a strip of cardboard exactly 6mm wide, then use this as a "spacer" between the LED and the board. The accompanying photo shows the idea.

Drilling the front panel

Fig.7 shows the front panel artwork – this can be used as a template for drilling the front panel. You will need to drill 11 holes for the LEDs, plus four more to mount the board. In addition, you will have to make a 6 x 6mm cutout for the infrared receiver (IC2) – you can do this by drilling a hole and then filing it to shape.

A hole is also required in the side of the box, to allow access to the DC

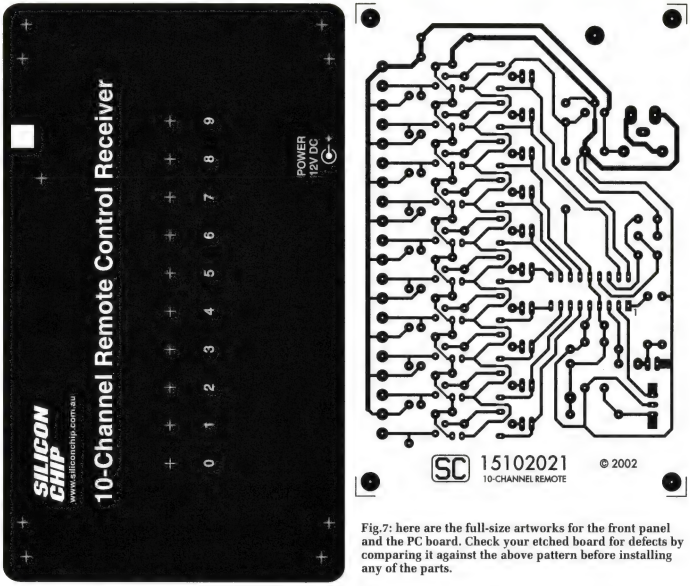


Fig.7: here are the full-size artworks for the front panel and the PC board. Check your etched board for defects by comparing it against the above pattern before installing any of the parts.

socket. Once the holes have been drilled, the PC board can be mounted on four 10mm-long tapped spacers and secured using countersunk machine screws through the lid and cheesehead machine screws through the PC board.

The LEDs are installed on the copper side of the board using a 6mm strip of cardboard as a spacer.

Testing

Before testing, you have to set the infrared transmitter to code 424. To do this, first press both the SET and SAT switches together – the transmit LED should light. Now enter 424 by pressing the 4, 2 and 4 buttons. The transmit LED will now go out and the remote control codes are now set correctly for the receiver.

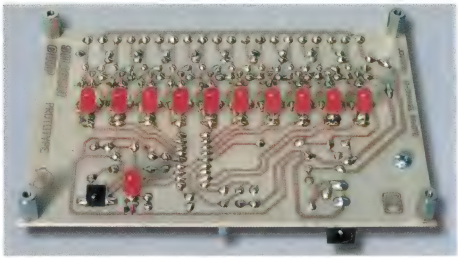
Now apply power and check that there is 5V between pins 5 & 4 of IC1's socket. If this is correct, disconnect the power, install IC1 and apply power again. Now press each of the number buttons on the remote control in turn. The receiver should now light the LED associated with the button pressed (ie, if 0 is pressed, LED0 should light).

The behaviour of each LED indicates whether its corresponding output has been wired for momentary or toggle operation.

If you wish, you can now check the operation of the optional second code by installing link LK1. The transmitter will now have to be programmed to code 425 instead of code 424.

Note also that the transmitter can be programmed with the code number placed in any of the SAT, VCR or TV options. This means that if you build two receivers, they can both be controlled using the same transmitter.

All you have to do is set code 424 for (say) the SAT button and code 425 for the VCR button – in the latter case, you press SET and VCR simultaneously and then press 425. Note that the second remote receiver must have LK1 installed, while the first receiver



The LEDs and the infrared receiver (IC2) are installed on the copper side of the PC board and protrude through matching holes in the front panel of the case (ie, the lid). Make sure that all these parts are correctly oriented.

Remote Control RC5 Codes

A standard RC5 control code consists of 14 bits (0-13). The first two are start bits, then comes a toggle bit, followed by five address bits and six keycode or command bits. The bits are separated by 1.778ms and the code repeats every 113.778ms. The scheme is as follows:

- Start bits (bits 12 and 13) – both high (1 and 1)
- Toggle bit (bit 11) – high or low (0 or 1)
- SAT1 address – 8 (bits 6-10) 01000
- SAT2 address – 10 (bits 6-10) 01010
- keycode 0 (bits 0-5) – 000000
- keycode 1 – 000001
- keycode 2 – 000010
- keycode 3 – 000011
- keycode 4 – 000100
- keycode 5 – 000101
- keycode 6 – 000110
- keycode 7 – 000111
- keycode 8 – 001000
- keycode 9 – 001001

should have LK1 omitted.

To control the first receiver, you simply press SAT and then one of the 0-9 number buttons. To control the second receiver, press VCR and then one of the 0-9 buttons.

Output control

As mentioned earlier, Fig.5 shows how to connect the outputs to perform various functions. Fig.5(a) shows how to drive a LED; Fig5(b) shows how the LED in an optocoupler can be driven, with the transistor output providing an isolated switch; Fig.5(c) shows how to drive a relay; and Fig.5(d) shows how to drive a motor via two relays, to provide for forward and reverse control (note: you must use two outputs from the receiver for this, one driving RLY1 and the other driving RLY2).

The NO and NC contact designations refer to whether they are normally open (NO) or normally closed (NC) when the relay coil is not energised. The common terminal (or wiper) is referred to as "C". Power for the motor can be from the 12V supply if they are 12V motors. Lower voltage motors will require a separate supply.

Power supply

Power for the unit comes from a 12VDC plugpack. This must be rated to cater for the loads that will be connected to the 12V supply rail, so you need to add up the likely current drawn by the loads. Typically, you will require a 500mA 12V plugpack when there are no small motors connected and a 12V 1A type when a motor is connected or if all 10 outputs are driving relays. **SC**

Parts List

1 PC board, code 15102021, 88 x 130mm
1 plastic case, 157 x 95 x 53mm
1 front panel label, 92 x 154mm
1 12VDC plugpack (power rating to suit application; see text)
1 preprogrammed remote control (eg, Jaycar 'Big Shot 3' Cat. AR-1710; Altronics 8-In-One Cat. A-1007; or equiv.)
1 20-way screw PC terminal block, 5.08mm pitch (10 x Jaycar HM-3130 or equiv.)
1 18-pin DIL socket
1 4MHz parallel resonant crystal (X1)
1 19 x 19 x 10mm TO-220 heatsink
1 PC-mount 2.5mm DC socket
4 10mm long M3 tapped spacers
4 M3 x 6mm countersunk screws
4 M3 x 6mm cheesehead screws
1 M3 x 6mm screw
1 M3 nut
1 30mm length of 0.8mm tinned copper wire
2 PC stakes

Semiconductors

1 PIC16F84P microcontroller programmed with 10-rmote.hex (IC1)
1 infrared remote control receiver (Jaycar ZD-1952 or equiv.) (IC2)
1 7805 3-terminal 5V regulator (REG1)
10 BC338 NPN transistors (Q1-Q10)
11 1N4004 diodes (D1-D11)
11 5mm red LEDs (LEDs1-11)

Capacitors

1 1000µF 25VW PC electrolytic
3 10µF 16VW PC electrolytic
1 0.1µF MKT polyester (code 104 or 100n)
2 22pF ceramic (code 22p or 22)

Resistors (1%, 0.25W)

1 100kΩ	10 390Ω
1 10kΩ	10 300Ω
10 1.8kΩ	2 220Ω (1 for testing)
1 1kΩ	1 100Ω

WHERE TO GET THE SOURCE CODE

For those interested in programming their own microcontroller, the source code (10-rmote.hex) can be downloaded from our website: **www.siliconchip.com.au**

2.4GHz High Power A-V Link

Here's an easy-to-build project which will provide very reliable video and audio links over several hundred metres or more. With 0.5W output, it operates on one of four channels way up in the 2.4GHz band.

By ROSS TESTER

YOU WILL HAVE SEEN adverts for devices of this type – they've become quite popular in recent years.

Operating on a frequency of 2.4GHz (that's 2,400,000,000Hz for the uninitiated!), most have about 10mW or so output and while they work well over a short range, the range is limited by the low power.

This design has much higher power – around 0.5W output, in fact. So as you might expect, the range is very significantly extended. With the simple coax cable "whip" antennas shown here, the range is reliably 200m or more. But if you use a simple dipole antenna, you could expect much more range – maybe 10 times or more.

Gain antennas

Perhaps a word or two about how and why this is possible is in order. It is sometimes difficult for people to understand how changing antennas can give longer range.

The simplest analogy I can think of is using your own voice. You can talk at a certain level and you'll be heard up to a certain range. You can shout, and of course you'll be heard by people further away. You're increasing the power of your voice.

Or you could cup your hands around your mouth and project your voice in a certain direction. Those off to the side won't hear as much (if at all) but those in the direction you're projecting will hear much more.

That's the equivalent of using a directional antenna. You're concentrating power in one particular direction at the expense of other (unwanted) directions.

If you replaced your hands with a long length of pipe, those to the side would hear little, if anything. But those

at the other end of the pipe, even over a very much longer distance, could possibly hear you.

That's the equivalent of using a highly directional antenna. Very little energy is radiated in any direction except the one you want.

OK, now that we know how to get longer range by increasing power and/or using directional antennas, let's get back to the Audio/Video Link.

Modular construction

One of the biggest difficulties for the hobbyist working at ultra-high frequencies is the precision necessary in construction. As the wavelengths become shorter and shorter (and at 2.4GHz the wavelength is only a couple of centimetres), even resistor leads become effective little antennas – but probably in areas of the circuit you don't want radiation.

Surface mount devices (SMDs) have to a large extent solved that problem but they are rather difficult devices to work with given the normal range of hobbyist tools – and experience.

The beauty of this design is that it uses pre-built and pre-aligned modules from Oatley Electronics for both the transmitter and receiver. All you have to do is solder them to the PC board, add a few power supply components, input and output sockets and an antenna – and the project is largely completed.

Now before you say "too easy" there are a couple of wrinkles.

The first is the precision necessary in soldering the modules to the PC boards. If you think that soldering normal ICs and multi-pin sockets to PC boards is difficult, wait 'til you see this one!

The 12-way connector occupies a space of just 5mm x 1.5mm. And you have to solder every one of those pins in without any solder bridges. You'll need a steady hand and a very fine-tipped iron to do it. We'll take a closer look at this later on.

Second, you have to accurately cut the antenna to length. As we said before, at 2.4GHz, a few millimetres make a difference, so you're also going to have to be pretty careful with this.

Apart from that, construction should be quite simple.

The modules

There are two different modules, one for the transmitter and one for the receiver (as you might expect!). The transmitter is the smaller of the two, measuring 43 x 30 x 8mm. The receiver is 53 x 35 x 10mm.

Apart from the multi-way connection socket on the back which we mentioned before, the only other connection you need to make is the antennas, which solder directly to the modules.

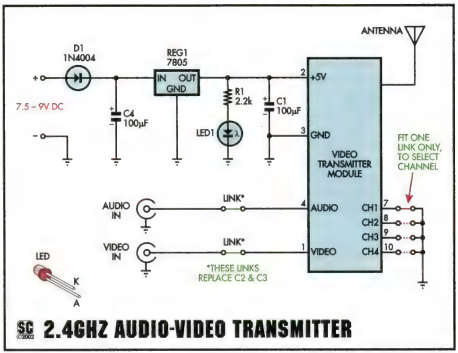


Fig.1: using the modules is easy – just add a 5V regulated power supply circuit, an antenna and the audio/video sockets. The operating channel is selected using a wire link.

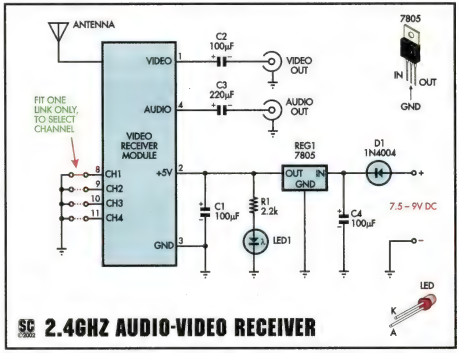


Fig.2: the receiver circuit is just as simple as the transmitter but note that different pin numbers are used to select the operating channel.

Just a word of advice: don't attempt to open the module cans to see what's inside. You're highly likely to damage them and there's nothing you can repair anyway.

The modules solder to identical PC boards but there are a few more components on the receiver board than the transmitter board. Both have on-

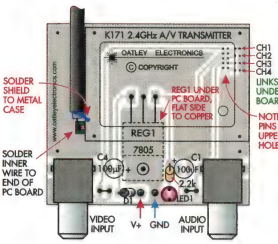


Fig.3: build the transmitter board by installing the parts as shown here. The 3-terminal regulator (REG1) is installed on the copper side of the PC board – see photo.

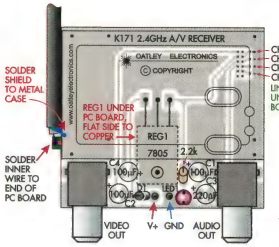


Fig.4: an identical PC board is used for the receiver but note that the parts layout is slightly different to that used for the transmitter. The channel selection link is on the copper side of the board.

board RCA sockets for audio and video input or output, a diode, resistor, LED and capacitor (three capacitors in the case of the receiver).

On the back of both boards is a 5V 3-terminal regulator.

On the prototypes (as photographed) there is another small electrolytic capacitor soldered across the regulator pins (mainly 'cos it was forgotten . . .) However, on production boards this electro will be transferred to the front, as shown in the component layout diagrams.

Construction

We suggest you leave the modules until last. Assemble the rest of the components on the PC boards – front side first, then the 3-terminal regulator (REG1) on the back.

The regulators screw to the PC board with a 3mm x 10mm machine screw and nut. Mounting them hard down on the board assists with keeping them cool – no further heatsinking is required.

Before soldering the modules to the PC boards, you have to cut and solder the antennas (assuming you're using the simple coax cable type). Fig.5 shows the coax stripping details.

Solder the antenna to the receiver or transmitter module with the inner conductor going to the antenna terminal and the braid, or shield, soldering direct to the module case as close as possible. Next, solder a loop of hookup wire from the module case around the antenna (coax insulation) and back to the case. This holds the antenna in place.

Now it's time for the difficult bit: soldering the module onto the PC board. We used the word "bit" to remind us of step 1: fit the finest-possible tip/bit to your soldering iron and make sure it is very clean and nicely tinned.

There is no easy way to solder the module in place and it's easy to accidentally bridge adjacent contacts. For this reason, it would be wise to have a roll of solder wick on hand to immediately remove any bridges you do make.

You'll also need a high power magnifying glass (a jeweller's loupe is better) and a bright light to visually inspect the board during and after soldering the module.

One possible tip for soldering this module: solder all the contacts as best you can and then use the solder wick to quickly remove the solder you've just placed. This should ensure that the pins pads are all nicely "tinned" and just need the tiniest of touch-ups with a hot soldering iron and some very fine solder.

Again, though, we would strongly advise a lit, magnified visual inspection of this section of the board before moving on.

And just in case you were wondering – yes, the transmitter only uses 10 of the 12 pads.

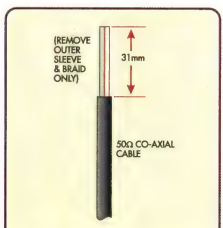


Fig.5: each antenna is made by removing exactly 31mm of the outer sleeve and braid from one end of some 50Ω coaxial cable.

Channel selection

Alongside the 12-pin contacts there are eight closely-spaced pads which are used to select the frequency on which the system works. This can be changed to avoid interference from other 2.4GHz systems. The same pair of pads must be linked on both the transmitter and receiver boards.

Alignment

Here's the quickest alignment of a transmitter and receiver in history. You don't have to do it – it's done.

Power supply

A 9V battery is not the best solution for this project – the input power is

around 1.2W so you'll be dragging about 130mA or so. It won't last long at all.

If you are using the system inside a building, a 9-12V, 300mA plugpack would seem the way to go. Outside, (or away from mains power), rechargeable nicads or NiMH cells would be a much better proposition. Six cells will give about 7.2V, leaving enough headroom for the 7805 regulator.

If long-term battery-powered use is contemplated, another possibility is to do away with the 7805 regulator completely and run the circuit (with appropriate track links) direct from 4 x 1200mA or higher nicads.

At 1.2V each, four cells will give 4.8V when charged – a tad under the 5V from the regulator but within the modules' spec. You would have to watch out for low voltage as the nicads drop their bundle but as a rule they do that rather quickly. You might need to also remove diode D1 to avoid its 0.6V loss but if you do, remember you have no protection against "oopses" with the supply connections.

1200mAH nicads are quite commonly available these days as are higher power "C" and "D" cells.

Another option would be a 6V gell cell. There's 0.6V drop across D1, bringing the supply to about 5.4V. If you think that's sailing a bit too close to the wind put another diode in series with the first for a 1.2V drop.

Testing

Once you have the power supply dilemma solved, hook up appropriate sources of video and audio to the transmitter. This done, connect a video monitor and amplifier to the receiver's video and audio output sockets respectively and apply power. You should have the modules separated by at least several metres for this check.

Assuming no mistakes, you should find that they work first up. There are no adjustments to make, with the possible exception of antenna length (but without specialised testing equipment even this is quite difficult).

Now you can experiment with the modules to see just what sort of range you can achieve. We'd be very surprised if it is less than a couple of hundred metres but remember, at 2.4GHz objects in the way can make a lot of difference – walls, trees, power lines, etc could be problems. You might even find that what works on a dry day is hopeless on a wet day (especially if your path is through foliage).

Incidentally, the maximum distance over which we have actually tested this link is 50 metres (yes, the length of my yard!). It worked beautifully – rock solid picture, great audio, etc.

This was in the week prior to Christmas but over the break I'm going to really put it through its paces.

Oatley Electronics report a number of these units have already been sold to people who have installed them on such things as hang gliders and balloons, with line-of-sight (air to ground) ranges in the several kilometres range. Pity I don't have a hang glider or balloon!

Data transmission?

While we haven't tried it and therefore cannot comment on success or failure, Oatley have also had reports of users putting these links in data applications, feeding in via the video input.

If anyone has any ideas (or better still experience) on this, we'd love to hear from you! **SC**

Parts List

2 PC boards, 55 x 48mm, coded K171 (Oatley Electronics)
4 mono PC-mount RCA sockets
1 2.4GHz video transmitter module (Oatley Electronics)
1 2.4GHz video receiver module (Oatley Electronics)
2 1N4004 power diodes (D1)
2 7805 5V regulators (REG1)
2 3mm red LEDs (LED1)
2 120mm lengths 50-ohm coax
Hookup wire for power supply connection, etc
2 M3 x 10mm machine screws, nuts and washers

Capacitors
1 220µF 16VW electrolytic
5 100µF 16VW electrolytics

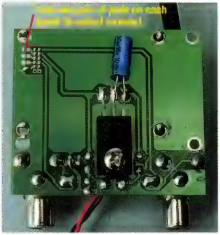
Resistors (0.25W, 1%)
2 2.2kΩ (red red red brown or red red black brown brown)

WHERE TO BUY THE KIT

A kit with all the above-listed parts is available from Oatley Electronics, PO Box 89, Oatley, 2223. Phone (02) 9584 3563 or email sales@oatleyelectronics.com. The price is $159 plus $7 for postage.

This view shows the completed transmitter unit. The antenna is secured with a wire loop soldered to the back of the module.

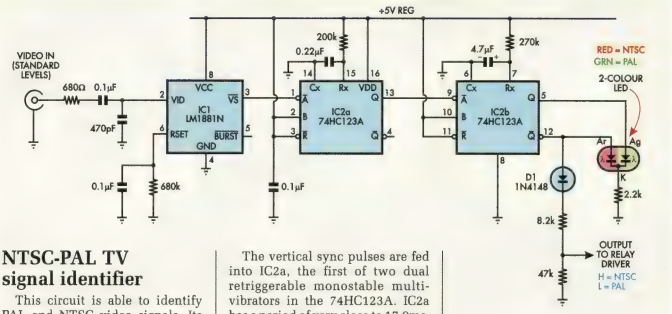
The matching receiver unit is similar to the transmitter. Don't forget to install matching channel selection links on the back of both boards.



Here's how the 3-terminal regulator is mounted. Ignore the 100µF capacitor – the board has been modified so that it's now mounted on the front.

CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.



NTSC-PAL TV signal identifier

This circuit is able to identify PAL and NTSC video signals. Its output is high for an NTSC signal and low if the signal is PAL. This output signal can be used, for example, to automatically switch in a colour subcarrier converter or some other device while an NTSC signal is being received. One application is for the reception from satellites of 'free-to-air' TV signals, which in Australia generally contain a mixture of 625-line PAL and 525-line NTSC programs.

Operation of the circuit is as follows. IC1 is an LM1881 video sync separator which takes the video input signal and generates vertical synchronisation pulses. For an NTSC signal, these pulses are 16.66ms apart, corresponding to the 60Hz field rate, while for a PAL signal they are 20ms apart, corresponding to the 50Hz field rate.

The vertical sync pulses are fed into IC2a, the first of two dual retriggerable monostable multivibrators in the 74HC123A. IC2a has a period of very close to 17.9ms, set by the 200kΩ resistor and 0.22μF capacitor at pins 14 & 15.

Because the monostable is retriggerable, NTSC sync pulses arriving every 16.66ms will keep its Q output, at pin 13, high. However PAL sync pulses arriving every 20ms will allow the Q output to go low after 17.9ms, before being triggered high again 2.1ms later.

Thus an NTSC signal will give a constant high output while a PAL signal will result in a train of pulses 2.1ms wide. The Q output from IC2a is fed to the inverting input of IC2b, the second monostable, which has a period of about 0.5s, as set by the 270kΩ resistor and 4.7μF tantalum capacitor at pins 6 & 7.

With its input constantly high, resulting from an NTSC signal, IC2b is not triggered and its Q output remains low. However, the pulse train from a PAL signal will constantly retrigger it, so its Q output will remain high. The period of IC2b also effectively makes it a low-pass filter which removes spurious switching due to any input glitches.

The output signal is taken from the Q-bar (inverted) output, so that an NTSC signal gives a high output, while PAL gives low. For the particular application for which the circuit was developed, diode D1 and the resistor network shown drive the base of an NPN switching transistor and relay.

A dual-colour 3-lead LED can also be fitted to indicate NTSC (red) or PAL (green). Note that with no video input, the output signal is high and will indicate NTSC.

G. F. J.,
Emerald, Vic. ($40)

Grand Prix starting lights

This circuit reproduces the starting light sequence currently used by FISA for Formula One racing. It could be used with slot car sets (such as HO scale AFX/Life Like/Tyco sets) or radio controlled cars.

IC1, a 555 timer IC, is used as a clock pulse generator. Its output is fed via NAND gates IC2a and IC2c to IC3, a 4024 binary counter. IC2b inverts the O4 output of 4024 binary counter IC3.

Initially, IC3 is reset and all its outputs are low, including O4, which causes IC2b to present a logical high to the pin 8 input of IC2c which then passes pulses from the 555 clock circuit to the clock input of the 4024. IC3 then begins counting. After the count has reached binary 1111, the next pulse sends the O4 output of IC3 high,

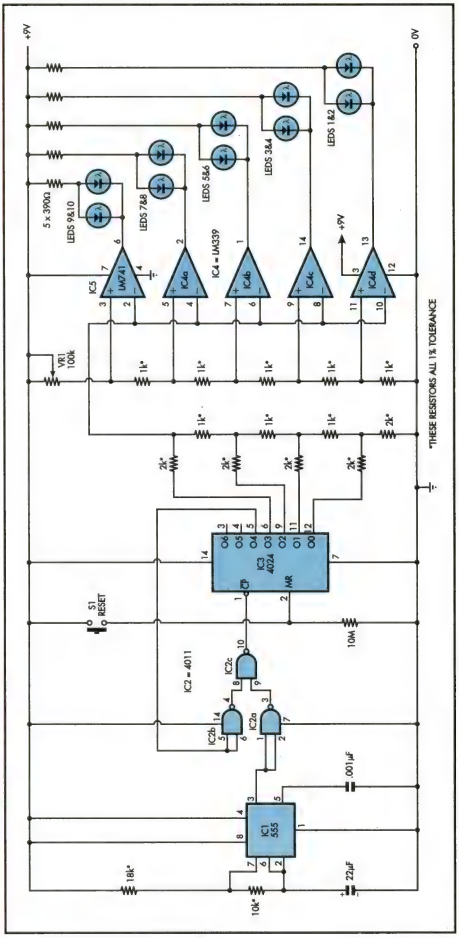
which disables IC2c and IC3 stops counting.

The four used outputs of IC3 are connected to a resistor 'ladder' which acts as a simple digital to analog converter (DAC). As the count increases so does the voltage produced at the top of the ladder and this is connected to the inverting inputs of four comparators inside IC4 (an LM339) and to IC5, which is a 741 op amp also connected as a comparator. The positive inputs of the comparators are connected to the taps of a voltage divider, with the tapping voltages set using VR1, a 100kΩ trimpot.

As IC3 counts, the rising stepped voltage from the DAC ladder switches the comparators on in sequence, starting with IC4d and working up to IC5. As each comparator is turned on, its pair of LEDs is lit; first LEDs 1 & 2, then LEDs 3 & 4 and so on. When all five pairs of LEDs are lit, the next pulse from IC1 moves the binary count of IC3 to 10000, so the DAC voltage drops back to zero and all LEDs are extinguished.

At the same time, counting also stops, because the high on O4 causes IC2c to block further gate pulses. The circuit then remains inactive until the counter is reset by pressing pushbutton switch S1. This allows a new sequence to begin.

David Richards,
Redbank Plains, Qld.



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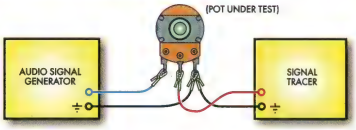

Tracking down scratchy pots

One of the most common faults in audio equipment is noisy pots – potentiometers that introduce scratching or crackling noises into the signal as they are adjusted. The problem is that sometimes a perfectly good pot will sound scratchy or crackly because of an intermittent connection or because DC is getting into it through a faulty capacitor or an out of balance direct-coupled stage.

So how can you determine whether a pot really is scratchy before going to the trouble of finding and fitting a physically compatible replacement? This solution is simple and involves a test setup which can be done with the pot still in circuit (but with the power off).

Using clip leads or temporarily soldered wires connected directly to the pot's terminals, connect the pot as a volume control between a signal generator and a signal tracer (or audio amplifier), as shown. Then adjust the pot up and down. If the signal tracer gives scratchy noises on top of the tone from the signal generator, then the pot is faulty.

Andrew Partridge, Kuranda, Qld. ($35)

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Low cost battery condition indicator

There are many published designs for battery condition indicators but they often require specialised and expensive components. This design combines power-on and low-battery indication, can operate with any battery voltage up to 15V, has very low current drain (2mA or less) and costs less than $3.50 with new parts.

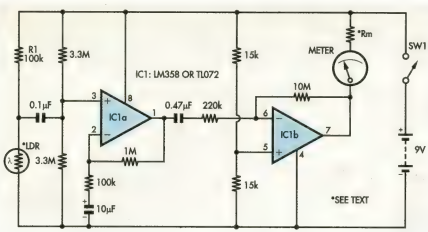
When the battery voltage is above a predetermined minimum, power on is indicated by what appears to be a steadily lit LED. In fact, the LED is being pulsed by a free-running relaxation oscillator formed by IC1c, one gate of a 4093 CMOS quad Schmitt NAND. The frequency of this oscillator should be at least 50Hz, so that it appears to be continuously on while at the same time drawing far less average current than a steadily lit LED.

The series resistor for the LED needs to be selected for each battery voltage, to limit the current to a safe vale or you could use a fixed resistor and a series trimpot for flexibility. Low battery voltage is indicated by the LED pulsing at around 1Hz.

The battery voltage is monitored by transistor Q1 and trimpot VR1. Once the voltage at its base falls below 0.6V, Q1 turns off and Q2 turns on to enable the 2-gate oscillator formed by IC1a and IC1b, which runs at 1Hz. The pulses from this oscillator are inverted by IC1d to gate the LED oscillator on and off.

Calibration can be done with a variable bench power supply set to the lowest battery voltage you will accept. Power up the circuit and adjust VR1 until the LED pulses once per second.

Peter Wilson, Winmalee, NSW. ($35)



Heart Rate Monitor

Strictly speaking, this simple circuit shouldn't work! How could anyone expect an ordinary light dependent resistor photo cell to 'see' through a fingertip in natural daylight and detect the change in blood flow as the heart pulsates? The secret is a high gain circuit, based on a dual op amp IC which can be either the low power LM358 or the JFET TL072.

The LDR is connected in series across the 9V battery supply via a 100kΩ resistor (R1) and the minute signal caused by the blood pulsing under the skin is fed to the non-inverting (+) input, pin 3, of IC1a via a 0.µF capacitor. Pin 3 is biased by a high impedance voltage divider consisting of two 3.3MΩ resistors. The feedback resistors to pin 2 set the gain to 11 times.

The output of IC1a is fed via a 0.47µF capacitor and 220kΩ resistor to IC1b. This is configured as an inverting op amp with a gain of 45 so that the total circuit gain is about 500.

The output of IC1b is used to drive an analog meter which may be a multimeter set to the 10V DC range or any panel meter in series with a resistor to limit the current to less than its full-scale deflection. The prototype used an old VU meter with a 47kΩ resistor fitted in series. Note that the unit was designed to use the Dick Smith Electronics light dependent resistor (Z-4801). Other LDRs may require a change in the value of resistor R1.

A light source such as a high brightness LED is not required. All that is needed is a reasonably well-lit room, preferably natural daylight, to produce a healthy swing of the needle. Only when the hands are very cold does it make it a little more difficult to accurately count the pulses.

To check your heart rate, carefully position your thumb or finger over the LDR and count the meter fluctuations for a period of 15 seconds. Then multiply the result by four to obtain your pulse rate. The circuit can not be used if you are walking or running, etc.

Tony Lee,
Old Reynella, SA. ($35)

SERVICEMAN'S LOG

Accidents do happen

Yes, accidents do happen. But these were not the usual kind. No dropped picture tubes, no vital components in the garbage, no lost accounts. Some jobs are acquired by accident, and can be risky propositions. But sometimes they can be quite profitable.

Mr Crown's six year old TV set, a 66cm GE 29GP480A (Thomson TX92), was a typical example and it came to me by accident. About four months ago the set had died and he dutifully took it to his local GE service agent. Three months later, this "specialist" told him it was a pile of junk he couldn't fix and didn't want to fix. He suggested he throw it out and buy a new one. It was an extraordinary thing for a service agent to say about the products he represents!

A lesser mortal might have left it there but Mr Crown was made of sterner stuff. He took it somewhere else and they at least made some progress – even though they weren't GE agents. The set was now no longer dead but still had a few intermittent faults that had to be fixed.

I know their principal technician personally and when I called in to have a cup of tea and a whinge about our lot, I cried about how quiet it had been since the GST came in – how business had dropped off incredibly now that new sets were 20% cheaper while repairs were up to 10% dearer. Apart from TVs, only top of the range VCRs are worth tackling – providing the faults aren't major.

Anyway, the point of all this was that, since I wasn't all that busy, he suggested that I might like to finish off the repair on the GE set – as long as I could do it within an agreed budget and time. Well, what could I say? I had to take it on.

I took it back with me to the workshop and switched it on. The faults were all intermittent and included poor video, green raster, cutting out and varying picture size.

Fortunately, my colleague had also supplied me with a circuit diagram, but that was all he had. Most of the problems seemed to be centred around the intermittent green raster and this was controlled by the screen control (G2 or A1, depending on your nationality) on the horizontal output transformer.

Sensitive control

The control was set fully anticlockwise and was very sensitive. If it was turned up, the picture's poor video would improve momentarily before going into a runaway bright green raster with the set cutting out.

I started by trying to check the main HT, supposed to be 130V, on the cathode of DP51. There are no voltages printed on the circuit but someone had pencilled this in. While looking for DP51, I noticed that resistor RP98 (270kΩ) had been unsoldered and half pulled out.

I resoldered the resistor only to find that the set was now completely dead. The reason for this was that surface-mounted transistor TP96 (BC858B) had been destroyed. A new one fixed that problem and also fixed a few other faults. The picture size no longer varied and the set did not cut out unless the beam current was ridiculous.

My colleague had already replaced ICs IF01, IF02 and IB01, the latter being a TEA5101B – the CRT video output amplifiers. I measured the voltages on the CRT base and found that the cathodes varied between 112V and 121V (green), while the screen voltage seemed to be low at 210V. I changed all the electrolytics on the board, especially on the 196V rail, but this made no difference. I then checked TB18 and the diodes. They were all OK except for DB72, a BAV21, which was leaky.

I didn't have a BAV21, so I fitted a 1N4148. This improved the picture dramatically, especially after I adjusted the screen control.

Occasionally, however, when I switched the set on to AV1, from cold, it would still go green. I thought there might be a chance of an intermittent heater control short in the picture tube, even though changing the channel would take it out of the green raster mode. Anyway, I reconfirmed that this was OK by patching it onto another tube.

Considering the high voltages in these circuits, BAV21 diodes (DB72, etc) are quite critical for the automatic greyscale (AUTO CUTOFF) control circuits. 1N4148 diodes are rated at 100V while BAV21s are rated at 250V. I ordered and fitted the correct ones – except they weren't surface mounted. This made the set a lot more stable but I was still doubtful about the screen voltage on CRT pin 7; it seemed low at 210V.

I entered the service mode by holding down the remote control blue TEXT (VT) button and switching the set on. This is a fairly useless MENU system, which isn't self-explanatory. The first thing I discovered was that the channel or AV cannot be changed

Items Covered This Month

- GE 29GP480A TV set.
- Toshiba 3429DXH TV set.
- Samsung TV-516 TV set
- Sanyo CPP 2930 TV set (A8-A29 chassis).

WE RECENTLY HAD A FRUSTRATING TIME WITH A SAMSUNG TV-516 WHICH HAD BEEN DROPPED...

when in this mode so, first, it is necessary to tune the default program 1 to the signal pattern generator.

Navigation through the service mode takes a little working out but modes can be changed with the yellow MENU button on the remote control and the values with the volume + and - buttons.

The first problem, after starting in the service mode, is finding out what various things are – eg, BRAND3 and BD1 and (later) what is PEAK?

There are five greyscale settings for the three colours but no instructions on how to set them up. I adjusted the green to improve the greyscale slightly and left it at that until I could get more information.

It was here that I ran into a brick wall. Despite having telephone, fax, and email facilities, trying to contact the main service agent was appallingly difficult.

No kidding; it took two weeks and half a dozen phone calls, faxes and emails to get a minimal response. Basically, technical support is only for dealers and has to be faxed, not phoned (which means, definitely, no questions answered). Phone calls are only to the receptionist who blocks any further calls higher up the ladder. Their website requires you to become a member. The only trouble is that its membership form submission doesn't work and no-one answers the email.

After two weeks, I finally received an email saying only dealers can use the website and the only service information I can get is by purchasing a CD. This I did and I eventually received it another week later. It carried 16 files with .DOC .DOT and .WPS extensions. These print out to a fairly good circuit explanation and a little fault finding but no voltages, alignment or adjustments, which was all I was really after. So much for technical support when needed.

I persevered with a few more faxes. Five days after the last urgent fax, they did eventually phone back and apologise for the delay; they told me their technician would telephone in a few days – and, surprisingly, he did.

The correct HT is 132V and the screen voltage normally lies between 200V and 250V, so 210V was fine. The screen control is set by first selecting an empty AV input (black picture) with the brightness set for mid-range and turning the control up until flyback lines can be seen, then backing it off a little.

In the service menu, Brand 3 means this particular model as opposed to others in this range. He didn't know what BD1 stood for. To set the greyscale in the service mode, one really needs to feed a pattern generator into one of the AV output sockets.

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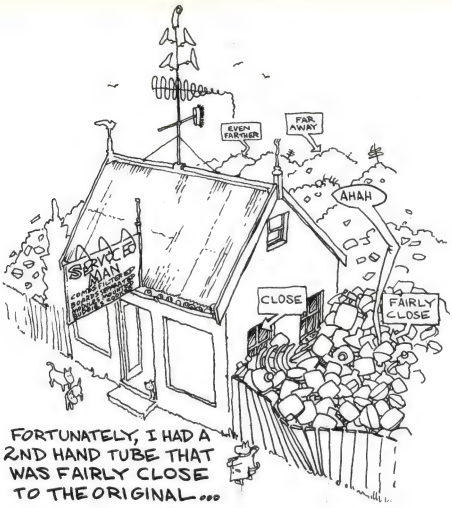

You can exit the service menu with the TV/OSD button on the remote control, select the AV channel and then re-enter the service mode with the VT/TEXT blue button. Now, with the colour control turned down to nearly minimum (but not completely), and brightness and contrast set to mid-range, you can adjust the five menu controls to set the greyscale visually.

It's not very scientific and probably difficult on an aging tube but this particular one wasn't too bad. On a normal TV set, one would adjust the cut-offs in low light areas and the drives on high bright/contrast areas. On this set, one can only assume that R-DC and G-DC are the cut-offs.

Anyway, I was fairly happy that I had indeed fixed the set but I was troubled that the screen control was set so low and was so critical. Mr Crown, however, was pleased with the result even if I was dubious.

Troublesome Toshiba

And talking about accidental jobs, how about this one! I never met the owner of this 1992 Toshiba 3429DXH that came in but I can imagine his frustration the set. This is an overseas model and judging by the 2-pin plug, was probably bought in the United States or Japan. And because it was a 28-system automatic multi-voltage set, all he had to do was to plug it into the power here in Australia, tune it in and it would have worked.

And it probably did for years without a hitch until, recently, it was found by the roadside awaiting a council cleanup. The person (or persons) who found it carried the 70kg 86cm TV set to the nearest secondhand TV shop and sold it for $50. Their technician, whom I know personally, switched it on to find that the picture and sound were initially excellent but, after 30 seconds or so, it would lose sync (particularly vertical) and the picture would "go funny" – almost negative.

A simple fault, one would think, and fairly easy to fix but you would be wrong. First, this set has all the bells and whistles and then some – it even has karaoke! Secondly, access to the chassis is appalling. It has three flat chassis along the bottom of the case with plug-in modules that are soldered in. To get to the solder side of the main boards, it is necessary to unplug a lot of connections before it can be turned over, which means there can be no measurements underneath while the set is on.

Without a circuit, it was going to be impossible to know where to start. There are two tuners, two IF panels and a 64-pin jungle IC, as well as a 64-pin microprocessor – not to mention numerous peripherals.

The agents for Toshiba are Castel Electronics in Victoria and my friend was extremely lucky to purchase a poorly photocopied manual for $45. Even armed with this, the task was daunting and eventually he offered the job to me.

Why me?

Why do I take on work like this? I suppose I just can't help myself. Anyway, it was delivered to my service bench and I tried to make sense of how it all worked.

First, I had to try to control the set without the proper remote control and so I used a generic one (Pilot or VESA make ones that work this model). It was still hard to juggle the controls, which aren't an exact match to the set, but I was eventually able to tune in the local stations.

Tracing the signal through the five plan-size circuit diagrams wasn't easy, partially due to the poor photocopy but also because of mistakes in the schematic, particularly in following the video and sync paths. Often one would follow the path from what appeared to be a source only to find that the destination was the source with the arrows reversed on another module! Not only that but quite often they would become a dead end on a module.

I started on the Video Out from the IF unit board (pin BO) and followed it to a small 3-transistor circuit which had an output marked TV SYNC. The only problem, when I finally managed to hook an oscilloscope to the component side of this circuit, was that there was no output. This was exactly the sort of symptom I was seeking and I was starting to feel hopeful.

Unfortunately, it took about three hours of checking all the voltages (which were correct) and changing almost all the components before I realised that this circuit was only a TV sync detector and delivered a volt-

age to the microprocessor which helped determine the auto cut-off (no sync) and, presumably, the frequency.

I moved on from the main board via plug PVO2A-228 where the arrows suddenly went in the opposite direction but nevertheless the signal arrived at pin 36 of ICV01 (TA8777N) on the Back Terminal Board V003 (PB3013-1). This IC controls all the inputs and outputs from the three AV inputs plus the TV set. Once again, it took a bit of fiddling but I eventually managed to get the AV inputs to work and I connected a signal generator. Even so, the picture was still rolling and negative.

Next, I connected a monitor to the output monitor socket of the Toshiba. Surprisingly, the picture was perfect on the monitor but not on the set itself.

The output to the monitor was via pin 30 for ICV01, whereas the TV signal was now called Y OUT on pin 18 and I could see the sync pulse being crushed and the centre parts of the colour bars also being crushed. I felt I was on the right track and so I ordered a new IC. And then I discovered a strange thing – with the colour turned off, the picture on the TV set was perfect. In fact, it turned out that just turning off the burst was enough to make the difference.

The new IC finally arrived and I was disappointed to find it made no difference. All the inputs to this IC gave a perfect picture to the monitor output but not to the TV set. I replaced all the electros around the IC and checked all the voltages but they were OK. I then started replacing the transistors around the IC: QV11, QV12, QV10, QV7 and QV5 but they were all perfect.

I must admit I was beginning to feel

IT WAS HERE THAT I RAN INTO A BRICK WALL

defeated. I couldn't understand why when all the inputs were correct, the Y out wasn't.

I spent some considerable time investigating the colour circuits, especially the colour system circuit, on the chance that when the burst was present perhaps the wrong system was selected, causing the sync to change. I ordered and fitted a new jungle IC (IC501, TA8783N) but that made no difference; nor did indeed removing the Teletext Board U009 (PB3017) and linking FA and FE. I removed the karaoke board as well but again drew a blank.

By now I was beginning to follow another clue. When switching it on from cold the picture was perfect for nearly 30 seconds, which might mean that heat from something was the key factor – perhaps even the power supply. I tried heating and freezing components all over the set but still couldn't find anything sensitive enough to change the symptoms.

I went back to ICV01, and noticed a number of links drawn on the circuit that could reroute the signals. One, in particular, reroutes the monitor output to the TV set instead. These are marked #1 and #2, so I swapped the links. This was a small breakthrough as the picture was now stable on the screen, though the picture quality was poor.

Swapping another set of links marked JP from pin 26 "COL IN" from the COMB filter to the monitor output gave a perfect picture. This made me

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decide to investigate the COMB filter, which is connected via PZ01A.

Locating and separating this board (D-COMB/LT 1/P-TUNER U012A 3020-1) was a feat in itself. It was bundled tightly on the lefthand end of the chassis and was screwed in with the wiring harness on a plastic frame and surrounded by metal screening cans. The actual board was marked PB3305-1 and is part of the picture-in-picture circuit. I noticed that the output to the monitor from pin 30 of ICV01 also went via QV02 to pin 300, and then via Q211 and Q212 to a large special IC designated QZ01 and made by Sony.

This is a digital comb filter and actually consists of five surface-mounted ICs on a double-sided ceramic module inside a metal can. There are two analog-to-digital converters and two line memory ICs with a DCF microprocessor. The signal arrived at pin 1 of IC QZ01 and left via pin 13, then went through five more transistors before going back to pin 28 of ICV01.

The CRO showed that the signal was fine going into the digital comb filter but it wasn't coming out. I then found that freezing the IC would fix the picture for a short while. My previous attempts with heating and freezing obviously didn't work because of the metal screening and because the module was "buried".

I ordered a new IC (SBX1692-01; trade cost $72) and eventually received a substitute list with an SBX1765-01. This also specified that QZ10 should be changed from 10µF to 100µF on the IC input.

This was the final solution to this problem and completely fixed the fault.

The correct remote control is on back order so that I can finally access the P-I-P and Karaoke menus. Surprisingly, the picture on this 10-year old TV set is stunning.

In fact, I was so impressed with this set that I approached my friend and struck a deal to keep it. Basically, I would swap three 51cm secondhand remote control TV sets for it, which I worked out as being worth about $750. The Toshiba was worth about $5000 10 years ago and it performed like a new one.

We were both happy with this deal. But, privately, I couldn't help recalling the rhetorical question I asked myself when I first tackled the job: "Why do I take on work like this?"

Frustrating Samsung

I had a frustrating time recently with a 1996 Samsung TV516, which had been dropped. There was slight cabinet damage but the set was still working, apart from a purity problem. I had a go at degaussing and readjusting it but after trying external magnets, I reluctantly concluded that the shadow mask had moved inside the tube (A51KQJ63X).

Fortunately, I had a secondhand tube that was fairly close to the original and so I fitted that. The tube I fitted was a little older and used a different yoke, so the dynamic convergence wasn't as good as with the original one – but it was acceptable. All that was left was to adjust the greyscale and that meant getting into the service mode.

It also meant getting a service manual and, after that, there was the frustration of trying to make sense of it. It might as well have been written in a foreign language, because most of it was hopelessly inaccurate.

To get into the service mode, one has to press the "HIDDEN" service key - which didn't exist. Nor was there a "STATUS" key and, in the menu, there isn't any "AGING" mode. The service mode is actually accessed by pressing, in sequence, the STAND-BY, P.STD, HELP, SLEEP and POWER ON buttons on the remote control.

All I had to do was adjust the five greyscale menus, which I did. However, I made a mistake on one entry and wanted to cancel it, which I am supposed to be able to do by pressing the nonexistent HIDDEN or STATUS

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key. In the end, I phoned technical support who were very helpful. They suggested I press the reset menu option and correct the error.

So I did, not realising that this wipes out the entire EEPROM memory, including the options. When I tried to retune the TV set, it would only tune on UHF.

I had to go back into the service/factory mode (is there a difference?) and set up the "Option Bytes". The only trouble was I didn't have the figures for this Australian model. I went back to technical support and they didn't have them either but later faxed BYTE 0 = 40, BYTE 1 = 08, BYTE 2 = 23. The only problem was, this model had only two BYTEs, not three!

So I had to guess what the value was for each bit and calculate the byte 0 and byte 1 additions. I made BYTE 0 = 0 + 0 + 0 + 0 + 8 + 4 + 0 + 1 = 15, and BYTE 1 = 0 + 32 + 0 + 0 + 0 + 4 + 0 + 1 = 37 from the ambiguous list of options in the service manual.

I also had a look at a Samsung TV486 which had BYTE 0 = FC and BYTE 1 = 01. Unfortunately, I don't quite know what criteria they worked those out on.

There is no model number mentioned on the TV516 but I assume it is either CX, CK or CW. It is marked PIB03 on the main PC board under the horizontal output transformer and I assume this is an SCT 11B chassis variation.

It was all far too confusing for an old codger like me. I managed in the end, more by luck than judgement, to get the thing working properly. But my advice to anyone is that, before making adjustments to any menu, you should write down the values first – especially the OPTION BYTES. Whatever you do, do not Reset it!

A real mystery

Following this exercise in frustration, a reader brought in his Sanyo TV set and Sony VCR with a baffling problem. When playing certain parts of certain tapes, the TV set would switch on and off!

The TV set was a 1992 Sanyo CPP 2930 A8-A29 chassis, while the Sony VCR was a hifi SLV-X822AS. It was normally connected to the TV set via AV leads but the fault occurred just as readily via an RF lead on channel 36.

Well, where does one start with such a mystery?

Fortunately, the customer brought in a tape that would trigger the problem regularly and I was able to observe the problem first hand. However, if the tape was tested in another VCR and TV set combination, it had no effect. Similarly, I tried a variety of my own tapes in the Sony VCR but none would affect it.

So how could parts of a particular tape turn a TV set off and on? It took me a little while to think of how this could happen.

First, what could be different between various tape recordings? There is no clue just before the problem occurs, such as picture or sound degradation. However, many prerecorded tapes have Macrovision protection, a trick involving sync pulse distortion to prevent illegal copying.

Second, what ways are there to turn this TV set off other than via its remote control and the power switch? Well, there is an OFF timer and there is an auto shut-off feature which turns the set off after a broadcast has ended. And the latter is triggered when the sync pulses are no longer transmitted.

The common denominator for both of the above is the sync pulses, or rather, the lack of them. Having created a hypothesis that might meet the facts, testing it and devising a way to work around it is a lot harder.

I managed to obtain a service manual but imagine my reaction when I discovered that the only circuit missing was for the sync and reset module(s). Some sets have two separate modules and some have one combined. Nether are drawn in the service manual other than as a box in a block diagram.

I had to ask myself, is there an actual fault here with the VCR or the TV set, or is this a design problem? I tried connecting the VCRs and putting the tape in other players – but in the end, I felt this wasn't a fault; the TV set just wasn't designed for Macrovision. That being the case and because the set was nine years old, perhaps Sanyo knew about it.

Service bulletin

The next problem was that Sanyo no longer services its own products but fortunately they do have service agents, one of whom I know well. I asked my friend whether there were any technical service bulletins that might be similar to this problem. He had a good look before telling me the good news. There was one dated 27-4-94 (no. 24) for the CPP2930 and 2530 models, the fault being: "The TV set switches off and on (CPU resets momentarily) on VCR search mode".

The cause is put down to the fact that "the horizontal frequency detection circuit range is too narrow". Ironically, this didn't happen in search mode on this particular set but the rest was close enough for me.

It was then just a matter of purchasing a kit of parts and fitting them on the SYNC and RESET PC board (VE2689). Identifying their location was time consuming without the circuit or board layout but everything was otherwise straightforward and the modifications completely fixed the problem. SC

Jaycar ELECTRONICS

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WATERPROOF TORCH / STROBE EMERGENCY BEACON

NEW

This device features a torch and strobe light, both of which are sealed with rubber gaskets. The beacon is waterproof, tested to a depth of 100 metres and is powered by 3 x AA batteries. Not meant to replace approved EPIRB's or other primary beacons. A velcro style band and lanyard cord are supplied for fixing to a backpack, belt, arm, etc. 162 (L) x 44 (D)mm. Batteries not supplied use SB2425 pk4 AA Alkaline. Cat. ST-3028

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To Suit Mobile Phones

NEW

These surface-mount LEDs are used to illuminate the keypad and display on some of the more upmarket mobiles currently on the market. Change over your existing green or orange LEDs and treat your mobile phone to a trendy new face!!!! As used in Nokia 8210/6110/6150 (6 x LEDs reqd.) & 3210 (10 x LEDs reqd.). 30mcd output, wavelength 660nm, water clear lens. SMD package '0603', size 1.6(L) x 0.8(W) x 0.75(H)mm. Supplied with instructions. SMD soldering required. Sold in a pack of 6 LEDs. Cat. ZD-2020

$19.95 PKT 6

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NEW

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$14.95

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Cat. ST-3068 WHITE
Cat. ST-3069 BLUE

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NEW

HOME UNIT 30WRMS 6.5" SUBWOOFER

NEW

This excellent subwoofer utilises a band pass box design to provide good performance in a small enclosure. The inbuilt amp is rated to 30wrms and powers a 6.5" woofer. The amplifier has both line level and speaker level inputs with an input sensitivity control to balance the subwoofer volume to the rest of your system. The box measures just 260 (H) x 200 (W) x 350 (D) mm. Cat. AA-0512

$169

500 WRMS HOME SUB AMP MODULE

NEW

Delivers over a massive 500 WRMS+ into 4Ω. A "soft limit" circuit, stops the amps output from clipping suddenly - saving your sub(s) from damage. Auto turn-on, a variable 30-200Hz active lowpass crossover, stereo/mono switch, peak signal LED, crossover, phase switch variable up to 180° and line level RCA input with high passed "throughput" •Cutout required 255 x 255mm. •THD: <0.6% •S/N Ratio: 74dB •Input Imp: 9K ohm •Damping Factor: 107
Cat. AA-0510

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White LED Glowlight Pen

The latest "colour" in our growing range of eccentric glowlight pens! Twist action delivered pen nib plus a switch activated LED for writing in stylish LED lit colour! Also available: Blue (ST-3066 $11.95), Red (ST-3065 $9.95), Green (ST-3067 $9.95), Multi-colour (ST-3092 $24.95) and Ultraviolet (ST-3063 $14.95).

NEW

Replacement pen refill available ST-3064 $1.20.

Cat. ST-3071 White

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GOOT 240V 46 WATT SOLDERING PENCIL

goot

NEW

JAPANESE MADE

This high quality soldering pencil is made in Japan by Goot. Goot is a famous brand throughout the world, but virtually unknown in Australia and New Zealand, until now. This soldering pencil offers exceptional heat recovery. The ceramic heater is automatically controlled by the heating load of the tip. The tip temperature is set at 320° C. The power lead is made from silicon rubber, which is very flexible. Cat. TS-1430

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LCD SOLDERING STATION

Temperature is precisely controlled and can be set in increments of 1°C across the range of 150°C to 450°C. Up to 3 preset temperatures can be programmed into the control unit and instantly selected from the front panel push button. Each temperature preset is shown on the LCD control panel as well as the current tip temperature.
Cat. TS-1400 **WAS $249**

Designed in Germany

$199

SAVE $50

NEW PRODUCTS

Sometimes new products advertised here are held up due to unforseen circumstances. Before driving across town, please phone to check that the new products have arrived in your store.

HIGH CAPACITY RECHARGABLE TORCH

This torch features a Panasonic 4.2Ah 6V SLA battery and high brightness krypton bulb, giving a super bright concentrated beam. The torch is water resistant and has splash proof covers for the charger socket and on/off switch. A shoulder strap and 240V charger are included. Cat. ST-3082

SAVE $10

WAS $39.95 **$29.95**

3 LED HEAD TORCH

Cat. ST-3058

This versatile torch can be clipped onto your clothing or use its head strap for hands free use. The 3 white LED's emit as much light as a standard 2-cell torch but with a more even diffused light, and a super long battery life. Its uses are endless. Comes with 3AAA batteries. Also comes in a 1 LED version ST-3057 $19.95

$29.95

500,000 CANDLEPOWER RECHARGABLE SPOTLIGHT

This rechargeable torch puts out an incredibly bright light, similar cheaper units cant be compared, the battery in this light can be changed in seconds via a removable cover on the top, so you can have a couple of spares for long duration use. Operates for approximately 20 minutes. 240v charger and cigarette lead supplied. Cat. ST-3030

SAVE $$$

$39.95

BUY THIS TORCH IN FEB & BUY AN EXTRA BATTERY Cat SB-2496 FOR ONLY $12.50 SAVE $10

1 LED KEYRING TORCH

Have light wherever you go with this water resistant white LED torch, bright and compact in a strong aluminium casing with rubber grip.

Uses 3 button cells included. Cat. ST-3072

$19.95

DIGITAL COMPASS / CLOCK / THERMO Cat. QM-7260

Hand held digital compass features a large LCD display that provides 12/24hr time, date & day, temperature and direction. Cardinal points are displayed, and the numeric heading is displayed in 5-degree increments. The display features an EL backlit display for night use.

SAVE $10

WAS $79.95 **$69.95**

Digital Pocket Scales

Measure from 0 grams to 200 grams with a resolution of 0.1 grams and are compact enough to be carried in a shirt pocket. Measures only 120L x 78W x 22Dmm. Supplied with protective cover. See cat P111 for details. **WAS $199**

Save A Whopping $50

$149

Cat. QM-7246

GAFFER TAPE

You can never have enough gaffer tape and you can buy two rolls at a saving this month. Black in colour, 48mm wide and 25 metres long. Cat. NM-2810

SAVE $7

WAS $13.50 per roll

NOW $20 for 2 rolls

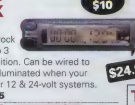
CAR CENTRAL LOCKING KIT

You can put this central locking in yourself and save hundreds on the installation costs. Supplied with all wiring harnesses and mounting hardware. Do not confuse our high quality locking kits with other lower price units, ours are designed to last. 4 Door kit Cat. LR-8830

WAS $59.95 **$49.95** SAVE $10

CAR VOLTAGE METER CLOCK / STOPWATCH

This unit gives you voltage, clock (12/24hr) and stopwatch; also 3 LED's show you battery condition. Can be wired to your dashboard lights so its illuminated when your light s are on. Can be used for 12 & 24-volt systems. Cat. XC-0118 **WAS $34.95**



SAVE $10

$24.95

KEYLESS ENTRY FOR CENTRAL LOCKING

The ultimate way to upgrade your central locking. This interface allows you to replace your keys making it quick and easy to get into your car at the touch of a button especially helpful when your hands are full. Supplied with all wiring, module and 2 remotes. Cat. LR-8831

WAS $79.95 **$59.95** SAVE $20

LEARNING KEYFOB REMOTE

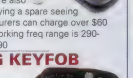
This handy remote is great if you have 2 cars and you want to put them all on one remote. They are also better value thanbuying a spare seeing that most manufacturers can charge over $60 for each remote. Working freq range is 290-410Mhz Cat. LA-8990

$39.95

LEARNING KEYFOB REMOTE

This remote is the same as above but its effective frequency is 250Mhz - 450Mhz

This remote is capable of controlling many car alarms and garage doors. Cat. LA-8992



$49.95

EQUATOR CAR ALARM

This alarm has all the necessary protection for your car, featuring learning/code hopping remotes, immobiliser, central lock control, backup battery siren, flashing dashboard light. For full details on this great alarm call in or see our 2001 catalogue page 182. Cat. LA-8855 **WAS $199**

SAVE $30

$169

LOW COST 6.5" SPLIT SPEAKER SYSTEM

SAVE $20

$59.50

These are great value splits, power handling 50 watts RMS. Cat. CS-2292 **WAS $79.50**

THE WINNING SOUND OF RESPONSE

Recently two brothers loaded up their Mazda 323 with 4 x 12" RESPONSE double magnet subwoofers (on left) and 4 x 150WRMS amps (on right). They won 1st place at Auto Salons "Final Battle 2001" in the Super Street 3-4 Subwoofer Division. They also won first place in the heavy weight division of the Autobahn's Small Car Sunday Soundoff. The boys were loudest for the day with a whopping 148.8dB.

2 X 150WRMS CAR AMP

Cat. AA-0434

SAVE $36

This amplifier packs a powerful punch capable of up to 438 watts continuous power when bridged.

WAS $335 **$299**

12" DOUBLE MAGNET SUBWOOFER

Cat. CS-2228

Power handling 250WRMS via its 2 x 4Ω voice coil.

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HEAVY DUTY SOUND BARRIER

This plastic - like barium-based mat is very effective at reducing panel vibration due to big sound systems and is installed using contact adhesive. 700 x 330 x 2.3 mm thick. Cat. AX-3680

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BUY 2 ROLLS FOR $18

HEAVY DUTY SOUND BARRIER WITH FELT

Same as our AX3680 but with a felt lining to absorb more sound and create a quieter car environment. 680 x 330 x 4.5mm. Cat. AX-3682

SAVE $9

WAS $18.50

BUY 2 ROLLS FOR $28

HIGH POWERED 50 WATT STROBE LIGHT

This high powered strobe uses a 50 Watt tube to produce a brilliant flash and can be used to great effect in large rooms or at dance parties etc. The strobe features a variable flash rate from 2 Hz up to around 10Hz and is housed in a sturdy metal case and fitted with an adjustable mounting bracket. 240 (W) x 220 (H) x 170 (D)mm •Fitted with a mains power switch, fuse and 900mm power cable. Cat. SL-2991

$129

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Clocks & Thermometers

If you are into aviation you will love these aircraft inspired desk & wall mounted clocks & thermometers. They are styled to resemble aircraft cockpit instruments and incorporate precision US made quartz clock movements and Canadian thermometer modules.

Three ranges are available which includes a desk-top model with alarm, a larger wall-clock as well as wall mounted combinations of clocks & thermometers.

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•85 x 85 x 33mm
Cat. XC-0155
$54.95

Directional Gyro Desk Clock
•85 x 85 x 33mm
Cat. XC-0156
$54.95

Artificial Horizon Alarm Desk Clock
•85 x 85 x 33mm
Cat. XC-0157
$54.95

V.O.R. Alarm Desk Clock
•85 x 85 x 33mm
Cat. XC-0158
$54.95

Altimeter Style Wall Clock
•165 x 165 x 38mm
Cat. XC-0150
$64.95

Airspeed Style Thermometer
•165 x 165 x 38mm
Cat. XC-0151
$64.95

Directional Gyro Wall Clock
•165 x 165 x 38mm
Cat. XC-0152
$64.95

Artificial Horizon 6.5" Wall Clock
•165 x 165 x 38mm
Cat. XC-0153
$64.95

V.O.R. 6.5" Wall Clock
•165 x 165 x 38mm
Cat. XC-0154
$64.95

Combination Altitude Wall Clock & Airspeed Thermometer
•190 x 380 x 48mm
Cat. XC-0163
$119

Directional Gyro Wall Clock & Airspeed Thermometer
•190 x 380 x 48mm
Cat. XC-0164
$119

Combination Artificial Horizon Wall Clock & Airspeed Thermometer
•190 x 380 x 48mm
Cat. XC-0165
$119

Combination Altimeter & Artificial Horizon Style Wall Clocks Cat. XC-0166
•2 clocks - ideal for different time zones
•190 x 380 x 48mm
$119

TECHSTORE BARGAINS

HOME SUB AMPLIFIER MODULES

We have some limited quantities of home sub amplifiers that are either shop soiled or ex repair. They are all in good working order and come with a 6 month warranty. All amps feature variable crossover and volume, RCA and speaker level input and auto switch on /off circuit. See page 81 of the Jaycar 2000 catalogue for more info.

Cat. AA-0505

200 WATT RMS @ 4 OHM
with infra red remote control Only 34 Available
WAS $359 NOW $239 SAVE $120
Cat. AA-0505

150 WATT RMS @ 4 OHM
Only 33 Available
WAS $319 NOW $199 SAVE $120
Cat. AA-0500 Cat. AA-0502

65 WATT RMS @ 4 OHM
Only 12 Available
WAS $199 NOW $109 SAVE $90
Cat. AA-0502

Cat. AA-0500

EQUATOR CAR ALARMS

These are ex repair EQUATOR car alarms. Complete with a 6 month warranty. These alarms feature code hopping/anti scanning remotes, engine killer, central locking control, LED warning light and shock sensor.
See page 114 of the Jaycar 2000 catalogue for more info.
2 styles of remote are available but we do reserve the right to supply what we have left in stock. Type A only 24 available Type E only 24 available

CAR ALARM
Cat. LA8950
WAS $189
NOW $119
SAVE $70

OLD STYLE CAR ALARM
With wood style 3-button remote.
Cat. LA-8902 ONLY 4 AVAILABLE
WAS $189 NOW $99 SAVE $90

Cat. LA-8902

USB TO PARALLEL CONVERTER

Connect your standard (IEEE-1284) parallel printer to the latest PDA's & slimline palmtop computers with this compact, high-speed bi-directional converter.
Cat. XC-4830 **WAS $59.95** **$49.95** SAVE $10

USB TO DB9 CONVERTER

This USB to 9 pin serial converter allows windows 98 pc with a USB port to use any RS-232C serial device via the USB port. Suitable for digital cameras, modems, POS systems etc
Cat. XC-4835 **WAS $84.95**
SAVE $10 **$74.95**

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Similar to our 9 pin USB to serial converter, this 25 pin version also allows windows 98 PC's with a USB port to use any RS-232C serial device via the USB port.
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TDK DIGITAL AUDIO	XC-4706	$1.95	$17.50
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PHILIPS GOLD	XC-4711	$1.95	$17.50
LASER GOLD 80 MIN	XC-4713	$1.65	$14.50
PYROD BLACK 80MIN	XC-4714	$1.65	$14.50
AVALON SILVER	XC-4715	$1.20	$10.50
AVALON CD-RW	XC-4720	$2.50	$22.10
PYROD SILVER CDR 25 PACK	XC-4712	$23.95	PACK 25
10 Pkt PYROD GOLD IN SLEEVES	XC-4717	$9.95	PACK 10
50 Pkt PYROD SILVER IN SLEEVES	XC-4718	$39.95	PACK 50

2 WAY DATA SWITCH BOX

Switch between 2 inputs to one output via D-25 sockets, full 25 pin wired.
Cat. XC-5062
WAS $21.50 **$16.50** SAVE $5

FRONT

BACK

NETWORK CABLE TESTER

$69.95 SAVE $20

This tester is suitable for TIA568A/568B, 10/100 Base-T (STP/UTP) as well as ethernet (Coax). The tester will automatically check cables for open circuit, short circuit and incorrect wiring. See catalogue page 154 for details.
Cat. XC-5080 **WAS $89.95**

DIGITAL CAMERA MEMORY CARDS

NEW LOW PRICES FOR 2002

Compactflash™

Rewritable, non-volatile storage. Fully compatible with CFA & PC Card ATA standard. •36.4x42.8x3.3mm

		CAT	Now	SAVE
16mB	XC4771	$99.95	$42.00	$57.95
32mB	XC4772	$165	$58.95	$106.05
64mB	XC4773	$295	$86.95	$198.05
128mB	XC4774	$409	$165.95	$243.05

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32mB XC-4776	$165	$55.95	$108.05
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See cat page 156 for our range of memory cards, adaptors and readers

AURA INTERACTOR BACKPACK & CUSHION

Cat. XC-1000 **$29.95**

Cat. XC-1005 **$29.95**

Some boxes are scuffed but everything inside is perfect.

These things are great! Lots of fun for kids and adults alike, a backpack designed to be strapped on your back when playing computer games giving you that extra realism to the game. Feel the action of each punch, crash, shot and explosion. The cushion sits on a chair for home theatre or computer.

CAT5e PATCH LEADS

LOWER PRICES FOR 2002

CAT No		WAS	NOW	SAVE
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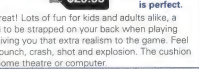
YN-8201	Blue	1.0m $6.95	$3.95	$3.00
YN-8202	Blue	2.0m $8.95	$5.25	$3.70
YN-8203	Blue	3.0m $10.95	$6.95	$4.00
YN-8204	Blue	5.0m $12.95	$8.95	$4.00
YN-8205	Blue	10m $18.95	$12.95	$6.00
YN-8206	Blue	15m $22.95	$16.95	$6.00
YN-8207	Blue	20m $29.95	$21.95	$8.00
YN-8208	Blue	30m $39.95	$32.95	$7.00
YN-8210	Red	0.5m $4.95	$3.25	$1.70
YN-8211	Red	1.0m $6.95	$3.95	$3.00
YN-8212	Red	2.0m $8.95	$5.25	$3.70
YN-8213	Red	3.0m $10.95	$6.95	$4.00
YN-8214	Red	5.0m $12.95	$8.95	$4.00
YN-8220	Yellow	0.5m $4.95	$3.25	$1.70
YN-8221	Yellow	1.0m $6.95	$3.95	$3.00
YN-8222	Yellow	2.0m $8.95	$5.25	$3.70
YN-8223	Yellow	3.0m $10.95	$6.95	$4.00
YN-8224	Yellow	5.0m $12.95	$8.95	$4.00
YN-8230	Green	0.5m $4.95	$3.25	$1.70
YN-8231	Green	1.0m $6.95	$3.95	$3.00
YN-8232	Green	2.0m $8.95	$5.25	$3.70
YN-8233	Green	3.0m $10.95	$6.95	$4.00
YN-8234	Green	5.0m $12.95	$8.95	$4.00
YN-8240	Grey	0.5m $4.95	$3.25	$1.70
YN-8241	Grey	1.0m $6.95	$3.95	$3.00
YN-8242	Grey	2.0m $8.95	$5.25	$3.70
YN-8243	Grey	3.0m $10.95	$6.95	$4.00
YN-8244	Grey	5.0m $12.95	$8.95	$4.00
YN-8272	Xover	2.0m $8.95	$5.25	$3.70
YN-8274	Xover	5.0m $12.95	$8.95	$4.00
YN-8275	Xover	10m $18.95	$12.95	$6.00

6 WAY MAINS FILTER WITH PHONE FILTER

Cat. MS-4036
WAS $39.95



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SUPER SURVEILLANCE CAMERA SPECIALS FOR FEBRUARY

OVERNIGHT DELIVERY AVAILABLE

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B+W CMOS CAMERA

This tiny camera measures just 35x35x25mm so you can hide it anywhere, resolution is 240TV lines and it can work down to 0.5lux.

STANDARD LENS
Cat. QC-3441

PINHOLE LENS
Cat. QC-3442

BOTH JUST
$59.95ea

B+W CCD DOME CAMERA

This camera is housed in a dark plastic dome and is ideal for mounting on a ceiling or a wall. Resolution is 380TVlines down to 0.5 lux.
Cat. QC-3472
WAS $119
SAVE $20
$99

COLOUR VERSION

330 TV lines, 2 lux.
Cat. QC-3484
WAS $249
SAVE $30
$219

B+W LOW COST QUAD PROCESSOR

This processor will accept up to 4 camera inputs. The processor enables you to see 4 pictures at once on a monitor or 1 at a time. A second output is given for VCR recording of all pictures. BNC connections are used for inputs and outputs.
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WAS $259
SAVE $30
$229

CCD PROFESSIONAL ALUMINIUM EXTERNAL CAMERA HOUSING

This housing is ideal for adapting our pro series cameras for any outdoor application, waterproof seals keep your camera safe from the elements.
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$39.95

Bracket to suit
Cat. QC-3336
WAS $34.95
SAVE $8
$26.95

MINI COLOUR CMOS CAMERA with AUDIO

This camera measures 20x20x16mm and incorporates a pinhole lens and also has an audio mic. Resolution is 380TV lines and will operate down to 4 lux and is powered by 9volts it can even be powered by a 9v battery.
Cat. QC-3459
WAS $159.95
SAVE $20
$139.95

B+W CCD BULLET CAMERA

Designed for use outdoors, this camera is weatherproof and has a ball & socket type bracket for mounting in all directions. Resolution is 380TV lines at 0.5 lux.
Cat. QC-3467
WAS $169
SAVE $20
$149

Also available in colour at 380TV lines down to 2 lux.
Cat. QC-3488
WAS $329
SAVE $20
$309

6" DUAL CHANNEL AUTO SWITCHING SECURITY MONITOR

Accepts up to 2 cameras. 240V plugpack supplied. Limited quantity available.
Cat. QM-3400
$129.50

TIME LAPSE VIDEO RECORDER

This VCR will allow you to record video and audio for up to 24 hours on a single 180min tape. For more features see page 197 in the Jaycar catalogue.
Cat. QV-3050
WAS $950
SAVE $100
Now $850 with any CCD camera purchase

DUMMY VIDEO SURVEILLANCE CAMERA

This camera looks just like the real thing - but isn't.So now you can give the impression that your house is under surveillance, a single D-cell powers a flashing LED.Cat. LA-5316
$34.95

B+W CCD CAMERA with AUDIO

This camera measures 39 x 39 x 26mm, the resolution is 380 TV lines and works down to just 0.5 lux.
Cat. QC-3474
WAS $119
SAVE $10
$109

COLOUR VERSION

330TV lines, 2 lux.
Cat. QC-3483
WAS $235
SAVE $16
$219

B+W CCD SURVEILLANCE CAMERA IN WEATHERPROOF HOUSING WITH AUDIO

This camera is designed for outdoor surveillance, icludes 6 infrared LEDs to illuminate the area under surveillance. Includes mains plug pack and 20mt Cable with Scart and RCA connections for easy hook up to your TV.
Cat. QC-3250
WAS $179
SAVE $30
$149

CMOS COLOUR VERSION.

Cat. QC-3252
WAS $225
SAVE $36
Limited quantity
$189

10" B+W SECURITY MONITOR

This high quality monitor will accept a single camera input or input from a quad processor. 240volt powered
Cat. QM-3402
$199.50

4 CHANNEL VIDEO SWITCHER

This switcher allows 4 cameras to be viewed one at a time or sequentially, you can vary the dwell time between each camera from 1 to 15 seconds. BNC connectors for video inputs and outputs and RCA's for audio.
Cat. QC-3481
WAS $169
SAVE $20
$149

REGULATED POWER SUPPLY

This plug-pack suits all of our cameras, regulated 12 volt output at 300mA terminated with a 2.1mm DC plug.
Cat. MP-3011
$24.95

B+W CCD PINHOLE CAMERA W/AUDIO

This camera measures 39 x 39 x 22mm; the resolution is 380TV lines down to 0.5 lux and can be hidden from view needing only a 1 mm hole to view through.
Cat. QC-3475
WAS $119
SAVE $10
$109

COLOUR VERSION

330 TV lines, 2 lux.
Cat. QC-3486
WAS $235
SAVE $20
$215

PRO STYLE B+W CCD CAMERA

This high quality camera is housed in a tough yet lightweight aluminium case and uses CS mount lenses (available separately) selectable for different surveillance coverage. Resolution is 380 TV lines down to 0.5 lux.
Cat. QC-3306
$125

COLOUR VERSION

330TV lines, 2 lux.
Cat. QC-3305
WAS $259
SAVE $30
$229

PRO STYLE CCD CAMERA LENSES

These lenses are designed for our pro style cameras and allow you to choose the viewing angle you require.

Cat. QC-3315 4mm LENS
Cat. QC-3316 6mm LENS
Cat. QC-3317 8mm LENS
SAVE $5
Were $ 39.50
NOW $34.50 when purchased with a pro style camera this month

CCD CAMERA EXTENSION CABLES

These pre terminated leads make it easy to hook up a camera system yourself.

5 Metre SAVE $5
Cat. WQ-7275 WAS $21.95
$16.95

10 Metre SAVE $7
WQ-7276 WAS $32.95
$25.95

15 Metre SAVE $8
WQ-7277 WAS $46.95
$38.95

20 Metre SAVE $10
WQ-7278 WAS $56.95
$46.95

OVERNIGHT DELIVERY AVAILABLE

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SMALL COMPUTER TOOL KIT

12 piece.
Cat. TD-2040
WAS $25.95

$19.95 SAVE $6

LARGE COMPUTER TOOL KIT

23 tools in a zip up case
Cat. TD-2041
WAS $78.95

SAVE $10
$68.95

AC / DC CLAMPMETER

SAVE $20

See cat. P32 for full specs.
•200A AC/DC •Frequency •Capacitance •Auto Ranging •Auto Power Off •Data Hold •One Touch Zero Function •Duty Cycle •Continuity •Carry Case •4000 Count
Cat. QM-1562
WAS $159

$139

LCD DIGITAL CALIPERS

SAVE $15

$64.95

Make fast and accurate measurements in seconds I.D or O.D from 0 to 150mm readable in mm or inches. Resolution is 0.01mm \ 0.0005".
Cat. TD-2082 **WAS $79.95**

SUPER DRILL SET

10 different attachments and different size collets allowing you to drill, grind, or cut. Supplied in carry case. 12000 rpm@12v.
Cat. TD-2460
WAS $69.95

SAVE $10
$59.95

6P/8P MODULAR CRIMPER

This tool will cut, strip and crimp both telephone connectors and cat 5 connectors quickly and easily.
Cat. TH-1935
WAS $59.95

SAVE $10
$49.95

SAVE ON LOW COST DMM

$11.95

19 range, 10 amp, transistor test, diode test, 3.5 digit display, plug in leads.
Cat. QM-1500
WAS $15.95

SAVE $4

SCREWDRIVER CARRY RACK

This organiser will hold 11 screwdrivers of various sizes slotting them in place so you can hang or carry them. Screwdrivers not included.
Cat. TH-1964
WAS $7.95

$5.95 SAVE $2

OPTIC FIBRE CRIMPING TOOL

Cat. TH-1840
WAS $55.95

SAVE $10
$45.95

17" TOOLBOX

Keep all your tools stowed away neatly, screws and crimp lug can be stored in any of the 4 parts boxes that store on the lid, a removable tray is also included for small tools.
Cat. HB-6326
WAS $15.95

SAVE $2
$13.95

MICRO NIPPERS

A high precision, angled nipper will reach

SAVE $3

into small spaces and give a professional neat job. Made from high carbon steel for cutting up to 22AWG soft copper wire.
Cat. TH-1894
WAS $16.95

$13.95

4 IN 1 STRIPPER

SAVE $3
$9.25

This tool gives you a wire stripper, cutter, crimper and pliers all in one. Cat. TH-1825
WAS $12.25

32 PIECE RATCHET SET

This kit includes 1 ratchet handle, sockets, screwdriver tips, torx tips, and allen key tips all in a flip top case.
Cat. TD-2043
WAS $23.50

SAVE $4
$19.50

12 Volt Compact Flouro Lights Slashed

These are a great innovation that gives you the energy efficiency of PL fluoro lights for use on 12-volt systems making them perfect for the car or caravan and for solar homes. (E-14 base required).

13 WATT 3D TUBE
Equivalent to 60 watt globe, 670mA, 140mm long.
Cat. SL-2850 **WAS $26.95**

$18.95 SAVE $8

20 WATT 3D TUBE
Equivalent to 100 watt light globe, 800mA, 150mm long.
Cat. SL-2852 **WAS $32.95**

$23.95 SAVE $9

E14 BASE (MES)
This base suits the above 12 volt flouro lamps. Cat. PS-4072

$3.95

COOL SAVINGS ON FANS

80MM FAN 12V

Cat. YX-2512
WAS $17.50

SAVE $5
$12.50

120MM FAN 12V

Cat. YX-2518
WAS $28.50

SAVE $5
$23.50

80MM FAN 240V PAPST BRAND

Cat. YX-2507
WAS $24.95

SAVE $5 $19.95

120MM FAN 240V

Cat. YX-2514
WAS $28.95

SAVE $5 $23.95

PLASTIC FAN GUARD/FILTER KITS

We now stock 3 new fan guards that filter dust from entering the fan. Plastic is rated to UL 94V-0

Cat. YX-2550 **60mm $4.50** Cat. YX-2552 **80mm $4.75**
Cat. YX-2554 **120mm $4.95**

NEW

MILLIENIUM LIGHT CHASER

SAVE $20

Uses 6 different coloured lights and a chaser, speed is variable, it's sensitive to sound, so it can flash to the beat or flutter with any sound. I.R. remote control so you can use it anywhere. Comes with integral stand or can be hung on the wall. 240v power supply included.
Cat. SL-2948 **WAS $149**

$129

JUMBO IN / OUT HYGROMETER

Combines temperature & hygrometer all on the one display, you can also recall min and max of both the temperature and humidity. Batteries included.
Cat. QM-7208
WAS $69.95

SAVE $10
$59.95

MINI FLOWER EFFECT LIGHT

This light projects light fragments (flowers) onto the dance floor or a wall. Runs on 240v, 50watt globe required, use SL-2726 $4.55.
Cat. SL-2940
WAS $139

SAVE $20
$119

JUMBO DISPLAY IN / OUT THERMOMETER

This thermometer will give both the inside and outside temperature on the one display and min/max readings are just the touch of a button away. Batteries included.
Cat. QM-7205
WAS $35

$28 SAVE $7

DURATECH GAS TORCH/SOLDER IRON

Doubles as both a small butane torch and a soldering iron with usable power of between 10 and 60 watts. Flame temperature can reach up to 1300°C. Supplied with torch head and 2.5 mm solder tip + catalyst.
Use our gas NA-1020 $5.95 Cat. TS-1685 **WAS $37.95**

$29.95 SAVE $8

SAVE $100 ON 5 SECTOR ALARM DEAL WITH DIALLER

This package contains all you need to install a comprehensive alarm system into your home. The list of other features can be obtained on the web or on page 170 of the Jaycar catalogue.
Cat. LA-5484
WAS $729

$629 SAVE $100

OVERNIGHT DELIVERY AVAILABLE

INVERTERS - 12/24V TO 240V

140 WATT - 12 TO 240V
This compact inverter is capable of running small devices up to 140 watts and can handle surges of 450 watts connects via cigarette lighter socket. Modified sine wave >90% efficiency, electrically isolated. Cat. MI-5060
WAS $109.50 $89.50 SAVE $20

400 WATT - 12 TO 240V
This inverter is capable of running larger items such as a TV & Video etc up to 400 watts continuous & 1200 watt surge, modified sine wave, >85% efficiency, electrically isolated.
Cat. MI-5064
WAS $199.50 $169.50 SAVE $30

400 WATT - 24 TO 240V
Same as above unit but for 24-volt systems.
Cat. MI-5065
WAS $199.50 $169.50 SAVE $30

800 WATT - 12 TO 240V
This large unit is capable of running such items as TV's, videos; power tools up to 800 watts & surge power of 2000 watts. Modified sine wave, >85% efficiency, electrically isolated.
Cat. MI-5068 **WAS $389** SAVE $50 $339

SWITCHMODE POWER SUPPLY

3,5,6,9,12,13.8VDC @ 2.5A
Cat. MP-3036
WAS $69.95 SAVE $15 $54.95

1.5A POWER SUPPLY
3,4.5,6,7.5,9,12VDC
Cat. MP-3035
WAS $49.95 $39.95 SAVE $10

0-260VAC VARIAC 500VA
Cat. MP-3080
WAS $199

$179 SAVE $20

LAB POWER SUPPLY
0-30VDC 0-3AMP
SAVE $20

This high quality lab power supply features separate voltage and current analogue panel meters as well as coarse and fine adjustment controls. Cat. MP-3081
WAS $189 $169

PIEZO TWEETER BARGAINS

ECONOMY 1005 TWEETER
Refer cat page 201.
Cat. CT-1907
WAS $11.95

SAVE $3 $8.95

ECONOMY 1141 TWEETER
Refer cat page 201.
Cat. CT-1908
WAS $22.95 SAVE $6

$16.95

CAMCORDER BATTERY CHARGER
Designed to charge Ni-CAD and Ni –MH batteries used with early camcorders such as Sony handycams, Panasonic VHS-C etc. Refer cat page 137 for more details
Cat. MB-3550 **WAS $59.95** SAVE $10
Adaptors available
- Sharp, Hitachi, Sony Cat. MB-3565 **$12.50**
- Panasonic, Canon, JVC Cat. MB-3566 **$12.50**
- 6 x AAA batteries Cat. MB-3572 **$12.50**

$49.95

SPEAKER SAVINGS

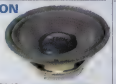
DOME TWEETER
- Freq Resp: 1.5k - 20kHz
- Impedance: 8Ω
- Sensitivity: 94dB
- Power:200WRMS

Cat. CT-2010
WAS $26.95 $18.95 SAVE $8

10" POLY WOOFER
- Freq Resp: 29-2kHz
- 8Ω
- Sens: 91dB
- Power: 160WRMS

Cat. CW-2137
WAS $129 $99 SAVE $30

12" CARBON FIBRE WOOFER
- Freq Resp: 25-3.5kHz
- Imped: 8Ω
- Sens: 93dB
- Power: 200WRMS



Cat. CW-2145
WAS $229 $199 SAVE $30

vifa D19 SOFT DOME TWEETER
SAVE $8
- Freq. Resp: 3k - 20kHz
- Imped: 8Ω
- Sens: 89dB
- Power: 100WRMS

Cat. CT-2019
WAS $34.95 $26.95

vifa D25AG 25mm METAL DOME TWEETER
- Freq Resp: 1.5k - 35kHz
- Imped: 6Ω
- Sens: 89dB
- Power:100WRMS

Cat. CT-2020
WAS $69 $49 SAVE $20

vifa 6.5" P17WJ WOOFER
- Freq. Resp: 37 - 5kHz
- Imped:8Ω
- Sensitivity: 88dB
- Power: 70WRMS

Cat. CW-2106
WAS $99 $79 SAVE $20

SPEAKER PACKAGES

JV60 HOME HI-FI SPEAKERS
The JV-60's use VIFA speakers from Denmark, each speaker uses 2 x 6" drivers and a 1" metal dome tweeter. They sound as good as built speakers costing twice as much! Power handling 100WRMS. The cabinets are pre built in black veneer MDF and have all the holes cut ready for fitting the drivers. Complete instructions supplied Call into any Jaycar store for a demonstration. See cat P213 Cat CS-2560

SPEAKER KIT $499
WAS $569
Cat. CS-2560 SAVE $70

OR BUY THE FULL KIT FOR ONLY $789 SAVE $100

PRE BUILT CABINETS
WAS $349
Cat. CS-2562 $319 SAVE $30

240W HOME SUB AMP MODULE
SAVE $50
This amp puts out a huge 240 watts RMS into 4Ω or 150 watts RMS into 8Ω; mounts in the subwoofer box by simply cutting a hole to size and screw it in. Has an in built variable low pass crossover, volume control and phase knob. Signal is fed via RCA leads or speaker cable.
Cat. AA-0501 **WAS $369** $319

8 SECTOR AV-GAD PRO ALARM DEAL
This new and improved AV GAD dialler alarm boasts an extensive array of features that make it one of the most advanced yet cost effective alarm panels available. The LCD keypad is microprocessor controlled and has a 2 line 32-character display. The keypad features its own list of up to 30 words, which can be customised to suit your requirements. Save time and money.

NEW

Pack includes: • AV GAD 8 sector alarm panel • AV GAD LCD pro keypad • 4 AV GAD PIR's • 3 wire power supply • 7Ah back up battery • 2 reed switches • 1 strobe • 1 ABS siren cover • 1 horn speaker • 1 internal siren • 4 deterrent stickers • 30mts 2 core cable • 200mts 6 core approved cable.

$1,099
Cat. LA-5488

PHONE CALL FOR ORDERS 1800 022 888

JAYCAR KITS

RAUCOUS ALARM

The Alarm That Everyone Will Hate Hearing

Ref: SC Jan 2002

NEW

This horrible sounding alarm plays eight notes in various sequences, and of varying duration, at a speed of about 150 beats per minute. Produces a very loud 2W RMS into an 8-Ohm speaker with a 12V input at roughly 500mA. Kit includes case, silk-screened front panel, PCB, speaker, plus all electronic components. Plugpack not included - use our MP-3006. Cat. KC-5327

$34.95

10 CHANNEL IR REMOTE CONTROL RECEIVER

NEW

Ref: SC Feb 2001

Use this inexpensive kit to control all manner of equipment such as hi-fi and video components, lighting, air conditioning, model railways, water sprinkler system - even the pool or spa filter's jet system. Transistor outputs are provided and these in turn can control relays or opto-isolators depending on your application. Designed to be used with pre-programmed remotes such as our AR-1710 model (not included). Supplied short form. Includes PCB, pre-programmed PIC micro plus all electronic components. Cat. KC-5326

$49.95

TOUCH &/OR REMOTE CONTROLLED LIGHT DIMMER

Ref: Sc Jan '02

NEW

Features include slimline appearance, soft-start to extend lamp life, last dim setting stored, full brightness on second touch, RFI suppression and remote control functionality. Kit includes PCB, brushed aluminium touch plate, PIC micro plus all elec components. •Remote control not included - use our AR1703 ($21.95). Cat. KC-5324

$69.95

PC INFRARED TRANSCEIVER KIT

Ref: SC Dec 2001

Did you know that most PCs (and specifically, the Pentium-class mother boards) these days include infrared support out of the box? This kit plugs into your motherboard to provide IR support for devices such as Notebook PCs, PDA Devices, Digital Cameras, Data Samplers, Desktop PCs etc. Kit includes PCB plus all specified electronic components. Cat. KC-5323

$27.95

NEON TUBE SOUND DISPLAY KIT

Silicon Chip Nov 2001

Following the tremendous success of the original 1997 Sound Mod kit, this latest version overcomes some of the original's limitations. With this latest kit you can now use any output from your car stereo – it is not limited to being exclusively driven by a subwoofer output, unlike it's predecessor. This kit drives any colour neon tube in the Jaycar range (see website) and has the option of turning the tube either on or off to the beat of the music. Kit supplied with PCB, silk-screened case plus all specified electronic components. Cat. KC-5322

$19.95

MINIMITTER KIT

Ref: SC April 2001

Plug your CD player into this transmitter and receive the transmission on your FM radio. Listen to CDs on a portable FM radio while you work in the garden or around the home. Includes case plus all electronic components. Includes 2 x AA batteries. Cat. KC-5310

$39.95

MULTIPURPOSE FAST BATTERY CHARGER KIT

Refer SC June 2001

Charges 1.2V to 14.4V in 1.2V steps for (NiCd), (NiMh) and (LiON) from 1.2Ah to 4Ah, as well as SLA Gel Cell and lead acid batteries at 6 or 12V @ 1.2Ah+. See website for more details. Kit supplied as shown. Cat. KC-5315 **Was $229.95**

$209.95 SAVE $20

MIXTURE DISPLAY KIT FOR FUEL INJECTED CARS

This very simple kit will allow you to monitor the fuel mixtures being run by your car. You can use it as a tuning tool, to help in vehicle modification or simply to see the behaviour of the engine control module. The circuit connects to the EGO sensor mounted in the exhaust manifold and the cars battery. Cat. KC-5195

$14.95

MIDI MATE INTERFACE KIT FOR PC'S

Ref Silicon Chip, Feb 2001

Turn your sound card into a full Midi port. Gives your PC and its soundcard a properly isolated Midi input, 2 standard Midi outputs and a Midi through output. Supplied with PCB, Case, Silk-screened front panel and all electronic components. Cat. KC-5306

Was $39.95

$33.95 SAVE $6

FOUR CHANNEL CCTV SWITCHER KIT

Refer SC June 2001

Variable scan rate, pause function. Kit supplied as shown. Requires 12VDC@150mA. Cat. KC-5316

Was $89.95

$79.95 SAVE $10

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Big, bold & beautiful . .

VAF's 2-Way T

Want to build a pair of speakers which are big, bold and beautiful and won't cost a fortune? Have a look at this tower speaker from VAF Research. It comes with fully assembled cabinets and virtually all you have to do is install the speakers and some hardware.

By LEO SIMPSON

Standing tall – the VAF DC-X tower speaker with the grille cloth frame removed. The big advantage of a tower speaker is that you get a big enclosure which takes up little floor space.

Each speaker system uses two woofers and a horn-loaded dome tweeter. Other items in the loudspeaker kit include the pre-wired rear connector panel, felt damping pieces to go around the tweeter and foam-backed adhesive tape for sealing around the woofers and the base panel.

...and they sound great

...wer Speakers

NOW WE HAVE already said that these speakers are big, bold and beautiful so if you are looking to build a pair of petite speakers to go on a bookshelf, these are not the ones for you. If you need to clear this purchase with your partner, tell her/him that they would be great as the front speakers in a top-quality home theatre system. And you can have them finished in real Cherry wood veneer rather than boring black.

Did we say they are big? Well they are quite tall at 1245mm but they don't take up much floor space – just 268mm wide by 306mm deep. In fact, there are plenty of much smaller speakers on stands that would take up more floor space but they won't have the punch of this system. In fact, this is the big advantage of a tower system; you get a big system but it does not take up any more floor space than a much smaller system.

No special tools are required to put the systems together. You will need a drill, hammer, screwdriver, soldering iron, sharp utility knife and not much else. When you have put them together, you will have a pair of speakers which look really good, with up-to-the-minute styling. They come with black finished top and bottom plates and a full width grille cloth frame which makes a nice contrast with the Cherry veneer side panels.

Actually, there are several models available. One with a stained black cabinet and wraparound grille cloth which slips over the cabinet like a sock and the other which comes in Cherry veneer. We assembled the Cherry version and in our opinion it is by far the more attractive of the two.

There is no assembly required for the cabinets themselves and that saves a heap of work. Nor do you have to worry whether your workmanship is up to par since the cabinets are of the same standard as that for finished systems on your hifi retailer's floor.

To help make the whole assembly process easier, we have taken a series of photos showing most of the steps required. While it does take some time, we reckon you could assemble one speaker in an evening, so after two nights you could be listening to fine music.

By the way, while the cabinets appear as simple towers, their internal structure is quite complex, with internal compartments and bracing. So they would not be simple to put together if you had a wish to assemble the cabinets yourself.

Drivers and crossover

Two 200mm (nominally 8 inches) woofers and a single horn-loaded dome tweeter make up the speaker complement in each cabinet. The

The tweeter is mounted on a recessed panel in the front baffle and then is surrounded with zig-zag shaped pieces of thick felt to damp any peaks in the response due to the cavity.

woofers are quite unusual in appearance. Instead of the common black polycarbonate cone, these have a woven yellow composite fibreglass cone and black neoprene rubber roll surround. Four pieces of blue felt have been glued to the cones, presumably to damp unwanted cone resonances or modes of vibration.

The woofers, which are made in France, are fitted with a large ceramic magnet and have an edge-wound voice coil with a diameter of about 42mm – quite large.

The effective cone diameter of the woofers is 150mm, giving a total ef-

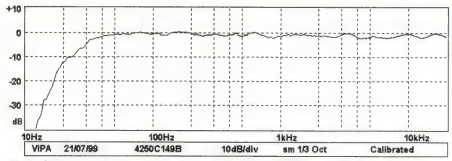


Fig.1: the on-axis frequency response is within ±2dB from 35Hz to 20kHz.

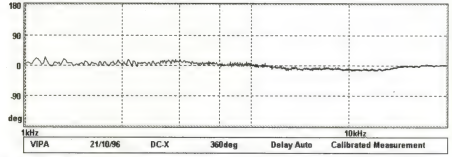


Fig.2: the on-axis phase response is exceptionally flat.

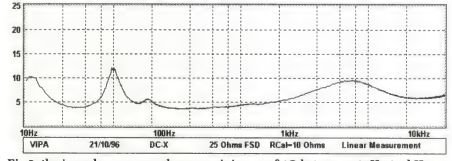


Fig.3: the impedance curve shows a minimum of 4Ω between 100Hz & 1kHz. Note the characteristic "double-hump" at the bass end; typical of a bass reflex system.

fective bass cone area for the DC-X system of 353cm^2.

The tweeter is also interesting, being a horn-loaded soft dome type and fitted with a large ceramic magnet. It is mounted in a recess in the front baffle to give "time alignment" with the woofers. This recess is heavily damped with zig-zag pieces of thick felt to prevent any nasty peaks.

With all the cone treatment applied to the woofer, it apparently has quite an attenuated high frequency response because the DC-X manages with a very simple crossover network. The parallel-connected woofers are fed with the full frequency range from the amplifier while the tweeter is fed via a 3.3μF capacitor and 0.47Ω 5W wirewound resistor. These components are supplied already mounted on the inside of the rear connector panel so there is no extra work to be done with regard to that aspect.

Note that the rear connector panel features two pairs of heavy duty gold-plated binding post terminals and these are normally strapped together. By removing the gold-plated straps, you could "bi-amp" the DC-X systems (ie, use separate amplifiers for the woofer and tweeter) but we would not bother.

Regardless of the simplicity of the crossover network, the claimed frequency response is commendably flat, being within ±2dB from 35Hz to 20kHz and with useful output down to below 30Hz. See Fig.1. Moreover, the phase response is very flat, with a claimed ±5° between 100Hz and 20kHz (see Fig.2); that is the big advantage of using a really simple crossover network.

The impedance curve is shown in Fig.3 and nominal impedance is stated to be 6Ω although for a significant portion of the frequency spectrum between 100Hz and 1kHz, the impedance is around 4Ω. Interestingly, VAF Research describe the model DC-X as having cabinets which are a "unique tapered lossy line design". OK, so what about the bass port on the front baffle? Doesn't that make it a bass reflex? Well, yes and that is supported by a glance at the "double hump" of the impedance curve at bass frequencies.

But apparently the tapered chambers inside the enclosure, which are packed with a variety of foam damping materials, do pretty heavily damp the output from the rear of the speaker cones and so too, the port.

By the way, rated efficiency of 95dB/watt at one metre is very high and it means that the DC-X loudspeakers will give a very good account of themselves with a relatively small power amplifier in smaller rooms.

Recommended amplifier power is from 10-200W RMS per channel and presumably that applies to normal program material (ie, not continuous tones).

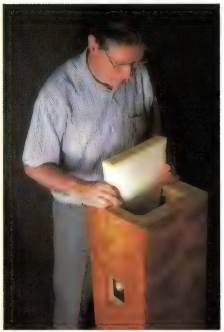
With a 100W (or high power) per channel amplifier, you can rest assured that the VAF Research DC-X speakers will produce a wonderfully smooth response on all types of music, particularly classical and jazz. They should give many years of sound satisfaction.

Cost And Availability

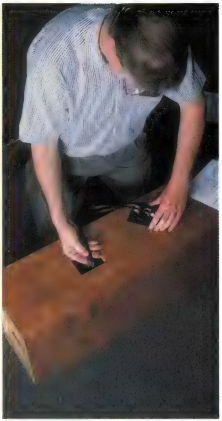
As built, with MDF cabinets in Cherry veneer, the VAF Research DC-X speakers are priced at $1399 a pair. You can check the VAF website at **www.vaf.com.au** to see all the various price permutations. You can also get the speakers fully assembled for an extra $330 a pair and for many people, that will be regarded as a good option, in spite of the fact that the assembly process is quite straightforward, as we shall see.

The DC-Xs come with detailed assembly instructions which are quite easy to follow. The following series of photos shows most, but not all, the major steps. The cabinets arrive separately packed and have some of the foam filling already in place.

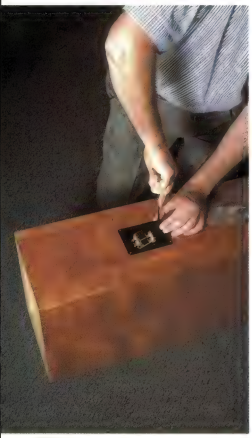
As well, you will receive a box with all the drivers, the rear socket panels with crossover network and speaker leads already soldered, and various other pieces of hardware, grille cloth, etc.



STEP 1: turn the tower enclosure upside down and insert two wedge-shaped pieces of foam into the bottom compartment. The pieces fit against each side of the cabinet, leaving a large free area in the middle. Three other foam sections need to be inserted if the cabinets do not already have it fitted.



STEP 2: fit the rear connector plate. Place the enclosure face down and pass the wires attached to the terminal plate through the hole in the rear of the cabinet, through the hole in the internal brace, to one side of the port tube and towards the front of the cabinet.



STEP 3: position the terminal plate in the hole, drill four pilot holes for the mounting screws and screw the terminal plate into place.

STEP 4: turn the cabinet face up and pull the labelled speaker wires through the respective holes in the front baffle.

STEP 5: Fitting the woofers: first, apply the black foam-backed tape around the holes for the woofers. This is to seal around the woofer frames when they are screwed down.

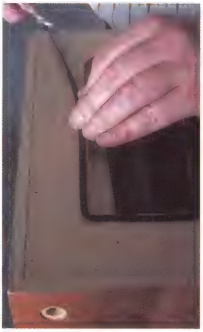
Step 6: solder the labelled wires to the terminals of the woofers. Do not solder directly to the terminals of the tweeter as it is too easy to damage them. Instead, we fitted some crimped quick-connects to the tweeter wires and then just pushed them on. Be sure to double check the polarity of all connections.

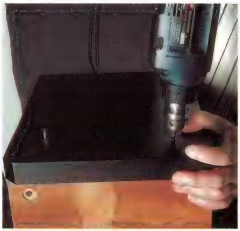
Step 7: fitting the felt pads: there are number of zigzag-shaped felt pads to go around the tweeter. These are glued in place to stop them from becoming dislodged.

Step 8: fitting the grille cloth Lay the two grille cloth frames face down on the grille cloth and cut it in half. You then fold the grille cloth over one of the frames and then secure it by pushing the supplied black plastic spline into the pre-cut channels. This job is made easier if you use a spline tool intended for use in making flyscreens.

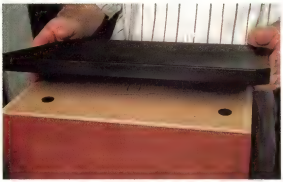
Step 10: install the cap clips into the front baffle – these allow the grille cloth frame to be clipped on the baffle.

Step 9: after the splines are all in place, trim the material all round with a sharp utility tool.





Step 11: installing the base & top: run foam tape all around the bottom cutout to seal it when the base panel is installed; then drill the holes for the base retaining screws and screw them home.



Step 12: the top panel is installed with the same cup clips as used for the grille cloth frame.

Step 13: the last step is to peel the adhesive backing from the VAF badges and position them on the grille cloth.

Right: the finished VAF DC-X tower speaker pair, with and without the grille cloth frame. The finished speakers really do look impressive.

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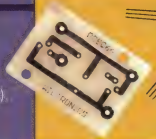

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TOUCH and/or REMOTE-CONTROLLED LIGHT DIMMER

Last month, we covered the design and board assembly of our new Light Dimmer. This month, we complete the construction, detail the touchplate and pushbutton extensions, and describe the test procedure.

Pt.2: By JOHN CLARKE

ONCE YOU HAVE completed the assembly of the main PC board (see Fig.3 last month), the metal contact screw can be installed as shown in Fig.7. This done, **cover the exposed end of the contact screw, the nut and the surrounding PC board area with a generous coating of neutral-cure silicone sealant, so that there is no exposed metal on the component side of the PC board.**

Smear the silicone sealant on with a wet spatula and make sure it adheres to the surface of the PC board. Apply a second coating if necessary.

The ends of the 4.7MΩ resistors should be cut off flush with the top surface of the PC board. **These resistor ends and the surrounding board area should also be covered with silicone sealant,** so that the mains cannot possibly directly short against them or the metal contact screw.

Extension circuit

The extension circuitry is relatively compact – see Fig.8. In its simplest form you can use a momentary contact mains switch which closes the Active and EXTN terminals when pressed. Alternatively, you can use another touchplate extension unit which includes the 4.7MΩ protection resistors and a few other components.

The touchplate extension operates as follows: if the touchplate is not touched, Q1 is held off via the 1MΩ resistor between its base and emitter.

If the touchplate is touched and the Active is above ground, Q1's base is pulled low via D1 and the 2.2MΩ resistor. This switches on Q1 and the EXTN connection is pulled to the Active. This will operate the main dimmer circuit in the normal way.

The .01µF capacitor acts as a filter and prevents sudden transients from driving Q1. Zener diode ZD1 protects against excessive voltages at the cathode of D1. This zener and the 220Ω resistor at the collector of Q1 provide protection if the connection to the main circuit is reversed. In this case, ZD2 will be forward biased (thus protecting Q1), while the 220Ω resistor provides current limiting.

Construction

The extension circuit is built on a PC board coded 10101022 and measuring 52 x 72mm. As with the main dimmer board, it is installed into a Clipsal blank plate with a blank aluminium touchplate.

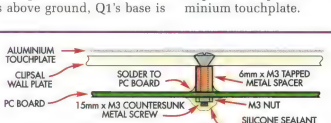


Fig.7: this cross-sectional diagram shows how the metal contact screw is mounted so that it makes contact with the aluminium touchplate. This arrangement is the same for both the main unit described last month and the extension board. Note the silicone sealant over the end of the screw and the nut (see text).

The completed dimmer will mount to a metal wall box where fitted in a brick wall **but it must be spaced from this using a 30mm or deeper mounting block** (otherwise the circuit may make contact the metal box). It can be mounted directly to a stud (Gyprock) wall using standard mounting hardware. Alternatively, it can be placed on a thin or standard surface-mounting box.

Once again, begin by checking the PC board against the published pattern to ensure there are no shorts between tracks or any breaks in the copper. Repair these as necessary.

Now check that the holes are drilled to the correct size for the larger components. The screw terminal mounting holes need to be 1.5mm in diameter, while the PC board mounting holes and the touchplate connection should be 3mm in diameter.

The resistors, zener diodes, the diode and transistor can now be installed on the PC board. The parts list shows the resistor colour codes. Alternatively use a digital multimeter to measure each value.

Make sure that the two 4.7MΩ VR37 resistors are placed in the correct position and don't substitute for these components. These are high-voltage

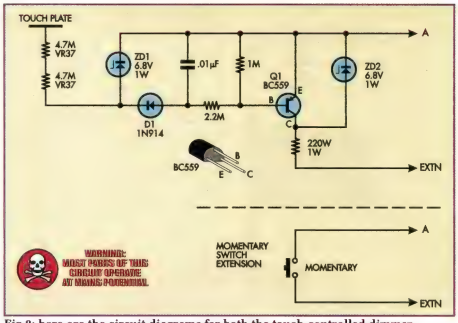
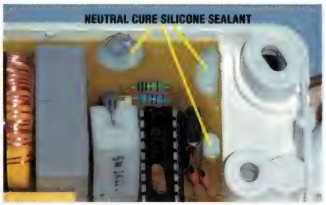
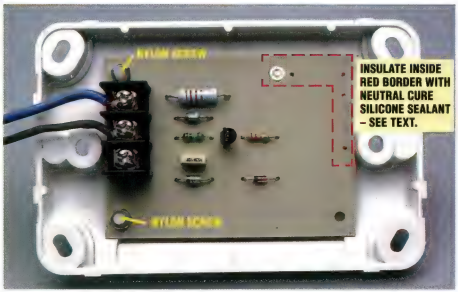


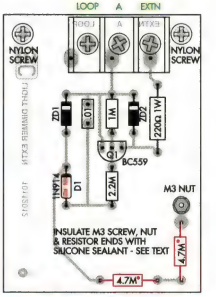
Fig.8: here are the circuit diagrams for both the touch-controlled dimmer extension (top) and the simpler pushbutton extension using a mains-rated momentary switch.



This photo shows how the contact screw and nut and the 4.7MΩ resistor holes are covered with neutral cure silicone sealant. Do the same for both the main dimmer board and for the extension board shown below.



The completed touchplate dimmer extension mounted in its Clipsal blank plate. The lowest terminal on the three-way block is not connected to anything; it is the equivalent of the "loop" terminal on a conventional light switch. Note that all exposed metal parts inside the red boarder must be insulated with neutral-cure silicone sealant, as shown in the top photograph.



*THESE COMPONENTS MOUNTED UNDER PC BOARD

Fig.9: the PC board parts layout for the touchplate extension. Note that the two 4.7MΩ resistors must be Philips VR37 high-voltage types (do NOT substitute). They are mounted on the underside (ie, the copper side) of the PC board.

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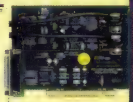
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Parts List: Pusbutton & Touchplate Dimmer Extensions

Pushbutton Extension

1 Clipsal CLI31WE architrave plate
1 Clipsal CLI30MBPRWE 'Press' momentary contact switch

Touch Plate Extension

1 PC board, code 10101022, 52 x 72mm
1 Clipsal CLIC2031VXBA blank aluminium plate and blank plate
1 3-way PC screw terminal block (Altronics P 2102 or equiv.)
1 M3 tapped x 6mm metal spacer
2 3mm x 6mm untapped spacers
2 M3 x 16mm countersunk Nylon screws
1 M3 x 15mm countersunk plated metal screw
3 M3 nuts
Neutral cure silicone sealant

Semiconductors

1 BC559 NPN transistor (Q1)
2 6.8V 1W 10% zener diodes (ZD1,ZD2)
1 1N4148, 1N914 signal diode (D1)

Resistors (5%, 0.25W unless stated)

2 4.7MΩ 1W VR37 Philips high voltage resistors (no substitutes)
1 2.2MΩ 0.25W (red red green gold or red red black yellow brown)
1 1MΩ 1% 0.25W (brown black green brown or brown black black yellow brown)
1 220Ω 1W (red red brown gold or red red black black brown)

resistors that are rated at 2.5kV RMS and are specified for safety reasons. They are light blue in colour and are mounted on the underside of the PC board. Their leads are then cut off flush with the top surface.

The capacitor can be installed now, as well as the 3-way terminals. The mounting screws and the metal contact screw are installed in exactly the same manner as for the main dimmer unit. **As before, use neutral-cure silicone sealant to cover the end of the metal contact screw, its nut and the ends of the 4.7MΩ resistors.**

Testing

Your next step depends on how confident you are of your construction. You could install the dimmer in the wall if you are supremely confident that you haven't made any mistakes but for the rest of us mere mortals, it's probably wisest to check the operation first using a low-voltage AC transformer and a 12V light bulb. This requires a bit of mucking about but it is the safest option.

Note that if you don't go the low voltage route, the components are live when it is wired up to the mains and so the plate must be securely located onto a wall before power is connected. By law, you must have a licensed electrician do this for you and of course, the power must be switched off at the fusebox to install the unit.

Before installing the unit though, carry out the following safety check. Switch your multimeter to its highest range and measure the resistance between the Active terminal and the touchplate contact screw. The resistance should be close to 10MΩ, or there should be negligible pointer deflection if you have an analog multimeter.

Do this for both the main dimmer and for any touchplate extensions. The test will ensure that there is no fault at the touchplate. If the circuit fails this test, check that the correct value resistors have been used.

The method of connecting up the circuit using the transformer is shown in Fig.10. You will need a 12V 1.2W bulb and a transformer which delivers about 15V at 200mA or more. We used a 2155 type and powered it from the mains via a mains terminal block and power lead. The earth wire connects to the transformer body.

Operation of the power supply and zero voltage detection is provided via the separate lead connections to the 1kΩ resistor and the 680kΩ resistors respectively. You will need a 220Ω 1W resistor for the supply lead connection to the 1kΩ 5W resistor and the

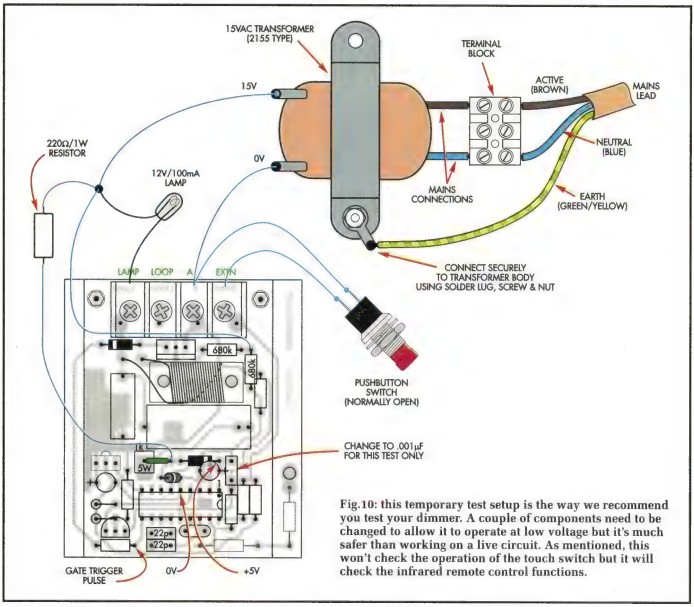


Fig.10: this temporary test setup is the way we recommend you test your dimmer. A couple of components need to be changed to allow it to operate at low voltage but it's much safer than working on a live circuit. As mentioned, this won't check the operation of the touch switch but it will check the infrared remote control functions.

.01µF capacitor needs to be changed to a .001µF (coded 1n0 or 102).

This capacitor will prevent the phase control running into the next half cycle due to a shift in the zero voltage detection point caused by the lower voltage operation. The range of phase operation is not the same as for mains voltage operation but is sufficient for test purposes.

Note also that the touch input will not operate with this low AC supply and any dimming control will need to be done with the handheld remote or by momentarily shorting the EXTN and A terminals together using a momentary switch, or by simply touching two wires together.

Measure the power supply voltage at the anode of D2 and the cathode of ZD1. Note that measuring the zener diode voltage across ZD1 will give a reading of around 2V as this diode is being switched to conduct in the forward and reverse directions with the alternating supply voltage. Gate trigger pulses can be measured at the point shown. The trigger pulses can be seen with an oscilloscope, with locking of the trace set by the line lock (available in the oscilloscope trigger options) or by a probe connection to pin 6 of IC1.

The remote control decode, start/stop and tracer signals are available at pins 8, 1 and 7 respectively, while the remote control signal from IC2 can be monitored at its pin 1 output.

Remember to replace the .001µF capacitor with the correct .01µF value when testing is complete, before operating the dimmer on the mains!

Remote controls

The default setting for the remote control coding is with both pins 2 & 3 of IC1 connected to the 0V rail. This sets the code that the dimmer will respond to as TV1 using the RC5 code system. The following instructions apply to the Jaycar Big Shot 3 and Select 1 preprogrammed infrared remote controls.

If you are using a different type of "programmable" infrared controller,

CORRECTION

The specified Triac in the main dimmer unit should be an SC141E 6A 500V Triac (not an SC141D).

Specifications

Phase angles (typical)	Minimum brightness 152°; maximum brightness 34°
Touch Dimming	< 60ms no change; 60ms-640ms on or off; > 640ms dimming
Last setting to full brightness	2.5s
Dimming rate	3s from minimum to full or full to minimum brightness
Dimming steps	102 from minimum to full brightness
Soft start	340ms from off to full brightness
Remote control	Code options 4 (RC5 code TV1, VCR2, SAT1 and SAT2)
Fast up dimming (CH +)	2s from minimum to full brightness
Fast down dimming (CH -)	2s from maximum to minimum brightness
Slow up dimming (VOL +)	11.6 seconds from minimum to full brightness
Slow up dimming (VOL -)	11.6 seconds from full brightness to minimum
Instant off	Mute
Dimming steps	102
Mains frequency lock range	45 to 55Hz
Mains frequency for remote control to operate	47.5Hz to 52.5Hz
Triac gate drive	80µs at 50mA
Brown out reset voltage for IC1	4.68V (@120VAC mains supply typical)
Maximum lamp wattage	250W

you can find the correct code by trying the codes in the instructions that apply to Philips brands of equipment. You should be able to find one that will operate the dimmer.

If you are using the Big Shot 3 remote control you need to set it to code 191. This is done by pressing the SET and TV buttons together and then releasing these buttons. The transmit LED will light. Now enter the number 191 using the number buttons on the remote control.

The Select 1 remote control must be set to code 11414. Press both the CODE and Operate (red) buttons for two seconds and then release them. Enter the numbers 11414 using the numbered buttons. The Select 1 remote control will only operate the dimmer when it is set for the TV1 code.

The remaining code options using pins 2 & 3 on IC1 are for use with the Big Shot 3 or similar remote control. You only need to use another code if the TV1 code transmission also operates another remotely controlled item in your house.

Alternatively, if you have more than one dimmer in the vicinity, you can use a different code for each. The "Code Options" table shows the codes for each of the options. Changing the code means that the thin tracks that tie pins 2 & 3 to the 0V rail may need to be broken with a knife and re-soldered to the +5V rail.

For example, the SAT1 code needs the pin 3 connection to be broken and soldered to the +5V rail. The Big Shot 3 transmitter will also need to be changed to the new code. For SAT1, press SET and SAT together and then enter code 424. Note that you do not need to program the value into the SAT button selection. It could be entered using the VCR or TV button selection instead. To operate the remote dimmer, you need to select the button (TV, VCR or SAT) that the code was entered into.

If you select the VCR2 code for the Big Shot 3, it does have an error in its transmission for the MUTE function. We decode this erroneous transmitter code to provide the Off function for the dimmer so that the control operates correctly.

However, the VCR2 coding will probably not operate on Mute for a different brand of preprogrammed transmitter. So it is probably wise to

These are the "Select 1" (left) and "Big Shot 3" remote controls from Jaycar Electronics. Other remote controls that can be used include the Dick Smith Electronics Cat. G1223 and Altronics 8-In-1 (Cat. A1007).

avoid using this code selection unless the other codes conflict with other remotely operated equipment.

We did not use the VCR1 coding instead (which has correct transmission coding for the Mute) because its Mute code is the same as the Mute code for the TV1 setting. This is called a punch-through code which allows muting of the television sound while still set to control the VCR.

Installation

First of all, have you remembered to change that .001µF capacitor back to 0.01µF? Do it now if you haven't!

The dimmer circuit is easily installed into an existing dimmer or switch circuit because the wiring is the same using the Active (brown or red) and lamp-via-neutral (blue or black) wires. The extension wiring requires an Active connection for the extension unit and an extension wire which connects to the EXTN input on the dimmer. It can be installed into existing 2-way switch wiring or you can have an electrician install the wiring if this is not already present.

The loop terminals on the dimmer and extension are free to terminate any wires that require connecting together but are not part of the light switching. This is to duplicate the loop terminal provided on standard light switches. We show below the typical 2-way switch wiring and how to wire up the extension to the dimmer. You can use either a momentary contact switch or the extension touchplate dimmer to provide dimming from a remote position. The momentary switch can be used in an architrave switch surround, making it easier for installation where space is limited such as in a door surround.

Note that the dimmer plate normally runs just warm to the touch, due to the dissipation within the Triac and inductor when it is driving the lamp, the 1kΩ 5W resistor, the zener diode and any losses in the 0.1µF and 0.47µF mains capacitors.

The remote control must be directed toward the receiver on the main dimmer plate to obtain reliable operation. We obtained a reliable 7m control range for our prototype. **SC**

CODE OPTIONS

	PCB DEFAULT			
PIN2:	0V	0V	+5V	+5V
PIN3:	0V	+5V	0V	+5V
"BIG SHOT 3" CODE:	TV1 (191)	SAT1 (424)	VCR2 (334)	SAT2 (425)
"SELECT 1" CODE:	11414			

These codes suit the two recommended infrared remote controls. Other controls may work but the code setting options may be different. You will need to set the codes accordingly.

PLEASE NOTE!

This circuit operates on the 240V AC mains and most parts of the circuit are at mains potential and therefore DANGEROUS. Furthermore, installation into fixed wiring can only be undertaken by licensed electricians under current legislation in most states.

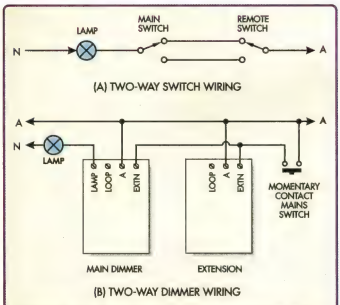
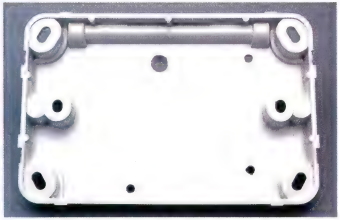


Fig.11: the top diagram shows typical 2-way domestic light switch wiring, with two conductors between the switches. Installing 2-way dimmers should allow the existing cabling to be used, albeit rearranged. The momentary contact switch must be mains rated and of robust construction.



This is the Clipsal CLIC2031VXBA blank plate (above) which we used for the dimmer and extension circuits.

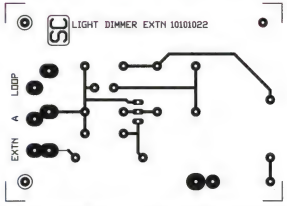


Fig.12: this is the full-size PC board artwork for the dimmer extension. The main PC board pattern was published last month.

A couple of months ago (December 2001), we introduced you to the "PIC FUN" concept by Adelaide company, eLabtronics. Now, as promised, we're going to put PIC FUN to work by turning it into a 4-way timer.

4-Way Event/Race/ Anything Timer

WHAT'S A 4-WAY TIMER? It's a device capable of digitally timing up to four different or related events at once. Slot cars on a race track, for example; or the first four sprinters in a race; the reaction times of four people of various states of sobriety (don't laugh – it's quite a legitimate test!); school physics experiments. And so on.

By the way, we're not suggesting those last two be combined!

It's accurate to 1/100th of a second so it is quite a useful device in its own right. And it counts up to 99.99 seconds – more than 1.5 minutes – so again it is very useful.

There are many more examples of where timers could be used – perhaps right now you're thinking of a pet project which lends itself perfectly.

Starting and stopping the timer is very easy using the Reset switch and the four pushbutton switches (S1-S4) situated on the lid of the box. But to make switching the timer on and off even more convenient, you can also use (prebuilt) infrared light beam relays for each of the four inputs. Whenever the light beam is cut, the counter stops.

As versatile as this system is, though, there will be places where you need different types of inputs. With just a tiny bit of ingenuity, these switches or light beam relays could be replaced with a whole host of electronic and/or mechanical "inputs" to make the unit do exactly what you want to do.

What sort of ingenuity? Perhaps it could be a pressure pad in a "gate" through which runners have to pass. Perhaps it could be as simple (and cheap!) as an external pushbutton switch. The switches are normally open so you can parallel them to your heart's content!

You get the picture, we're sure. All that is required to trigger the software is a 5V positive-going pulse.

Software

Software? We hadn't mentioned that yet! Of course, much of the software resides in the PIC microcontroller – it does the vast majority of the "housekeeping" of the unit. But there is other software which comes on a CD-ROM and allows the PICFUN2 Timer to be

By ROSS TESTER

used in conjunction with your PC, recording and saving information from the various timer inputs. We'll look at this much more closely in a moment.

Extra hardware

In the meantime let's get back to the PICFUN2 Timer itself.

We don't propose to go over the PICFUN2 PC board and its operation again – we covered that in the December issue. This time, we'll concentrate on what you have to do to build PICFUN2 Timer.

From the basic PICFUN2 board described in December, the following has been added:

(a) PORTA has extra terminal blocks and resistors for external connection. This allows all five ports of PORTA to be accessed for external wiring.

(b) Five switches have been added to connect to PORTA. This allows direct access to the ports for testing and other functions such as reset/start or possible menu selections on the LCD.

(c) Five connectors have been added to PORTA. This allows external devices to be connected to the PORTA pins via a sturdy connector. The power pins (+5V and 0V) are provided for external sensor power.

(d) A 7805 5V regulator allows extra loads on the power supply, such as external sensors on the connectors, while maintaining a stable 5V supply.

(e) A clock crystal: for accurate 1/100s timing, a clock crystal with a frequency which is divisible by a base 2 number to 100Hz is critical.

(f) An 16 x 2 line alphanumeric LCD display. A standard LCD module is connected to seven lines of PORTB. The eighth port (with the seventh port) is used for programming and/or PC communications.

(g) A box has been used to mount the parts – it all fits neatly into a standard size box.

Inside the box

Most of the real estate in the box is taken by the PICFUN2 board. It is in fact a little simpler than the earlier PICFUN2 project because the output devices are mostly removed. They're replaced by an LCD (liquid crystal display) module which mounts on the lid of the box.

Also on the lid are the four push-button switches previously mentioned and a master (reset) switch.

Four 4-pin sockets (for the infrared

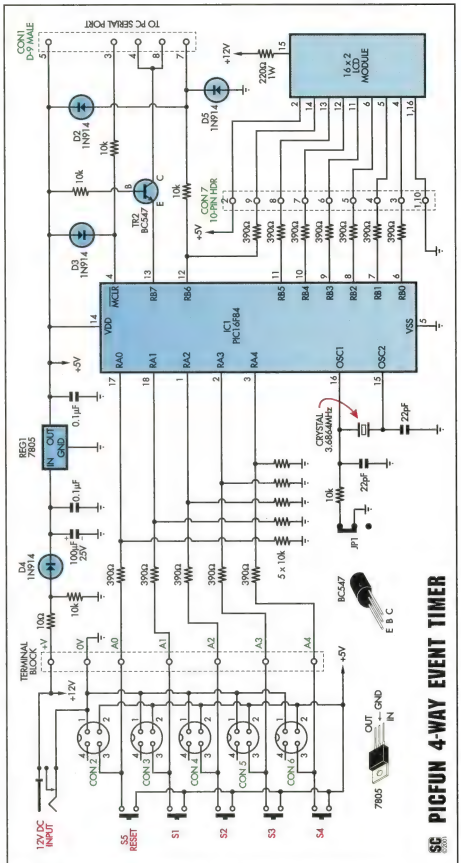
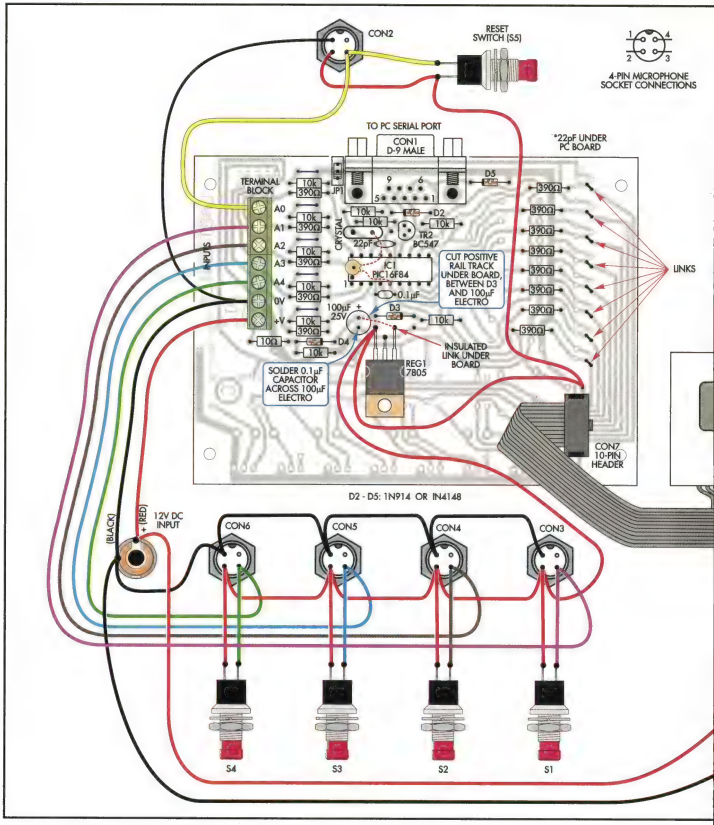


Fig.1: the circuit is based on the basic PICFUN2 kit described in the December 2001 issue but includes extra switches, connectors, a crystal (for accurate timing), a 5V regulator and an LCD to display the timing results.



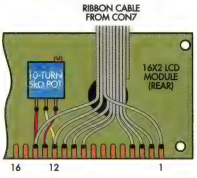
beam relays or other start/stop devices) are mounted on the back panel of the box while on the front is a DC power socket, a 9-pin "D" socket (for connection to your PC), a slider switch (toggles between programming and reading modes) and another 4-pin socket which can be used to "cascade" another PICFUN2 counter (or more).

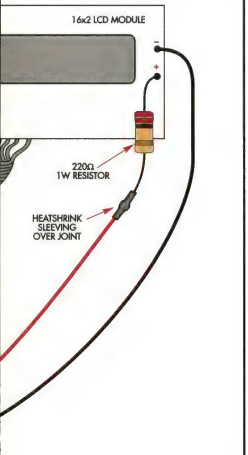
Power, by the way, is provided by a 12V DC plugpack, which is supplied with the PICFUN Timer kit.

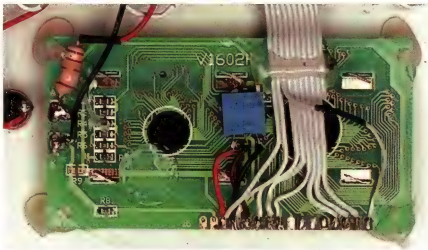
Construction

Most of the components which go on the PC board for this project are resistors – and most of these are one of

Fig.2: follow this diagram to assemble the PC board and complete the wiring of the 4-Way Event Timer. Note that the LCD module is modified by adding a trimpot and a 220Ω 1W resistor, as shown in the detail below.







This close-up view of the rear of the LCD module shows how the 220Ω 1W resistor, the multi-turn trimpot and the ribbon cable are installed. These parts can all be secured to the back of the module using hot-melt glue.

two values – 12 x 390Ω and 11 x 10kΩ ohms. Solder these resistors in first, followed by the only other resistor on the board, a 10Ω unit.

There are five capacitors. One 22pF capacitor (in the timing circuit) and one 0.1µF actually solder to the back of the board while the remainder, all associated with the power supply, are in normal positions on the top side. The semiconductor complement (ignoring the microcontroller for a moment) is four diodes, one transistor and the 5V regulator. Make sure all the polarised components go in the right way around.

Solder in the crystal and the PC board mounting terminal blocks (1 x 3-way and 2 x 2-way which interlock to form 1 x 7-way). Finally, solder in the header pin socket (used to connect to the LCD) and the 18-pin PIC socket. Don't put the PIC in just yet – leave it until the board has been checked out.

There is one above-board link (insulated thin hookup wire) from the regulator to the header pin socket for which no real provision is made. It solders directly to the output pin of the regulator (righthand most pin looking at the front) and solders to an empty pad immediately alongside the header pin socket.

Similarly, a connection must be made from the same point to a 4-pin connector (CON3) mounted on the rear panel.

The 9-pin D connector solders directly to the PC board and pokes through a hole in the front panel, while the DC socket and the program/run switch both connect via suitable lengths of hookup wire to their respective positions. The wires on the switch, in particular, need only be very short as they connect to the PC board immediately underneath.

The switch itself is held on the front panel by Araldite, hot-melt or other suitable glue.

Before we move on to the LCD module, there are a fair number of interconnections to be made between the PC-mounted terminals, the 4-pin sockets and the pushbutton switches. These are made with suitable lengths of fine hookup wire – follow the wiring diagram exactly and you shouldn't get into too much difficulty.

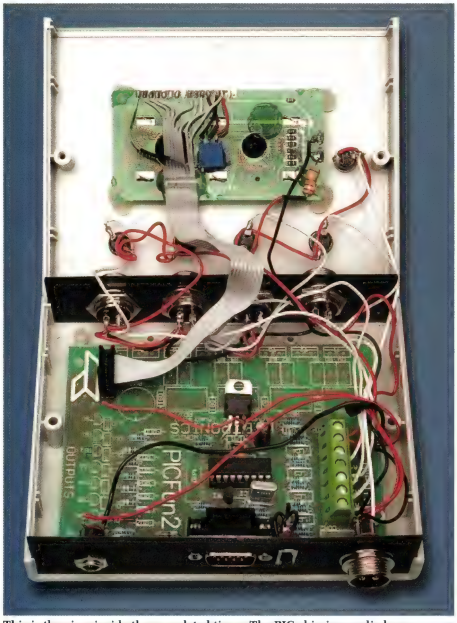
The LCD module

There are some modifications necessary to the module. A 220Ω 1W resistor needs to be glued to the back of the board to allow it to run from 12V. Also a multi-turn trimpot is glued onto the board, as is a length of ribbon cable which connects the module to PICFUN2 (see photograph and the detail diagram in Fig.2).

This terminates in a header pin plug at the PICFUN2 end but each wire must be soldered to its appropriate position at the LCD module end. Follow the diagram exactly – some pads on the module are not soldered at all while one wire must cross over its partners to go to the right place.

The multi-turn trimpot we mentioned before is connected to two of the same pads as the ribbon cable and to one other pad by short lengths of hookup wire. This pot varies the contrast of the LCD which also affects the viewing angle.

When you've finished soldering the wires in place, secure the trimpot and the ribbon cable to the board with Araldite or hot melt glue. And then



This is the view inside the completed timer. The PIC chip is supplied pre-programmed so the unit should work first time if everything is correct.

similarly glue the LCD module into its place inside the case lid so the display can be seen through the cutout.

Put in the PIC!

The final thing to do, once you've checked and double-checked your component placement and wiring, is to carefully insert the PIC chip into its socket. Make sure the notch on one end of the PIC lines up with the notch on the end of the socket – and also make sure that all pins of the PIC go into the socket, not bent underneath or splayed out (it's easy to do, trust us!).

The construction side of the project is now completed. You can use it as it is, so let's see if it works (after checking your wiring, of course).

Testing

The PIC chip is supplied pre-programmed so the unit should work first time if everything is correct. Because there are pushbutton "Start" switches and a similar "Reset" switch mounted on the case, you don't have to plug the remote triggering infrared devices in to check it out. And that's pretty important, because we haven't yet mentioned the remote triggering infrared devices!

Plug your 12V DC plugpack in and you should be rewarded with a message that says "00.00 seconds". That means the timer is ready to rock and roll.

All you have to do to start it is hit the "reset" button and you'll see the counter start, counting up in 1/100 seconds. Hit any of the four stop buttons and the display should halt (even though the counter is still running) with the exact time you pressed the button and the button itself nominated: "39.84 seconds – Stop4"

Press any of the other buttons and a similar message appears – the time of stopping and the button identified.

The infrared sensors

You don't have to worry about building the infrared transmitter/receivers, as they are supplied already built and tested. All you have to do is plug them into the appropriate 4-pin socket.

You can use one, two, three or four of these units, depending on your application. Two are supplied with the kit.

The transmitter and receiver must be aligned with each other so that they operate, and the beam must be where it will be cut by the person or thing you are timing.

Press the alignment switch on the Receiver Unit and adjust the angle of the units to get the maximum intensity on the red LED. The units are now aligned. Release the switch and the sensor is now ready to use.

Reprogramming the PIC

While the PIC comes pre-programmed, provision is made (via the D9 connector and the run/program switch JP1) to reprogram the chip at a later time if you manage to erase it (pretty difficult to do accidentally!) or if you are particularly clever and write your own code to make it do even more things. It's also possible that eLabtronics will also have updated software available (check out their website at **www.labtron.com.au**).

The original eTIMER.hex file is provided on the CD supplied with the kit, just in case.

LCD software

The LCD software is an assembler, or "ASM" file, which will compile and run directly on the PICFUN2 without modification. One of the features of this software is that the structure enables the user to keep a list of messages which can be easily called within the main program. Similarly, the com-

mand set is listed and can also be easily called up.

PC interface software

We mentioned earlier that the PICFUN Timer can be also used in conjunction with your PC. In fact, in this mode, its capabilities are significantly extended. Just some of the applications available are as a counter, a timer or even a quiz game timer which keeps scores.

Before you start, make sure your display properties setting in Windows is set to SMALL FONTS (otherwise the window may not fit the screen properly).

To set up the system for "Interface-To-PC", run setup from the CD. Plug the 9-pin female-to-female cable into the serial (COM) port on your PC but not yet into the PICFUN Timer socket. Make a note of the COM port you are using.

Also beware of using male-to-female cables with gender changers. These may not always be "straight through" connections which this project requires.

Once setup is completed go to your Windows Start menu, click on program and click on eTimer. The welcome window shown should appear. Click on the Welcome button, select the COM port you are using and then click on OK.

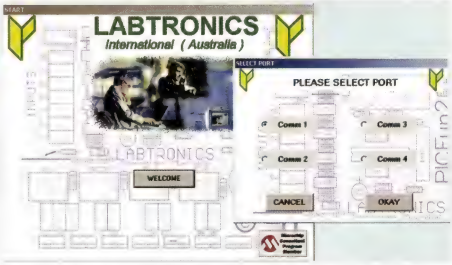
The default program which will load is the Quiz Game but you can change to the Infrared Timer or Counter by clicking on the OPTIONS menu and selecting the appropriate icon.

If the interface software is running properly, unplug everything from the PICFUN Timer (including power) and slide the programming switch up, towards the top of the box. Plug in the cable from your PC (it should still be connected to the PC) and then plug in power.

Hold down the RESET button while sliding the programming switch DOWN towards the bottom of the unit. The message "PC Interface" should now appear on the LCD display and your PICFUN Timer is now ready to run in the Interface-To-PC mode.

In all three modes of operation, you can enter the "players" names into your PC according to which button numbers they are holding. You can add or subtract their points, plot the results on a graph and even save the records in an Excel file.

The run/program switch (JP1) is mounted on the rear panel to allow you to reprogram or update the PIC microcontroller at any time.



Here's the welcome screen (left) that you'll see when you load the CD-ROM, along with the port selection screen (on the right).

After all the player's names have been entered, press the START button. (In the Infrared Timer mode, the start can be made with a start sensor; eg, the start of a slot car race). The timer will start counting.

When a player switch is pressed (or a race sensor triggered), the time counted for that player will stop while others will continue counting until their switch/sensor is closed.

SC

Where To Buy A Kit

The PICFUN Timer is available from eLabtronics, 12-20 Gilles St, Adelaide, SA 5000. Phone (08) 8231 5966. Website **www.labtron.com.au**

Prices are as follows:

eTIMER Kit (includes PICFUN2 Kit, LCD Kit, extra parts, plugpack and software)	$138.00
Built & tested eTIMER with two sets of IR sensors	$198.00
Extra set of IR sensors (built & tested receiver & transmitter)	$48.00
LCD Kit (ready to plug in, with ribbon cable and software)	$46.00

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Federal Court says Duracell's Bunny Race Ads Unfair

Duracell's "Bunny Race" advertisements, aired heavily in the weeks before Christmas, showing their pink rabbit winning a race across the desert against three other rabbits powered with non-Duracell batteries has been ruled misleading and deceptive by Justice Conti in the Federal Court of Australia.

With claims such as "Duracell always wins", the advertisements were found to be in breach of the Trade Practices Act because consumers would understand from the advert that Duracell batteries were three times longer-lasting than all other batteries – a claim not capable of being substantiated.

Eveready (Energizer batteries) took the action against Gillette (Duracell batteries) because they believed that the advert was not comparing "like with like".

Duracell argued that the comparison was between their highest-performance alkaline cell and Eveready's standard (ie, non-alkaline) black cell (only the 5th most powerful cell in their range) and that consumers would understand the difference because of wording in frames of the ad.

Justice Conti ruled that the advert was misleading for a number of reasons; not the least because no mention was made of the significant price disparity between the battery types. Consumers would have expected Duracell to use comparable performing cells in the Energizer range for their comparison. The use of different grades of batteries, not disclosed to viewers, was misleading.

Energizer obtained a permanent injunction against the adverts being shown again.

Tektronix closes its Australian operation; appoints NewTek as Australian distributor

US-based test equipment, video and telecommunications market leader Tektronix Inc has decided to "pull the plug" on its Australian operation.

However, the Tektronix name will not be lost with a new company, NewTek Sales Pty Ltd, appointed as Tektronix Australian distributors.

NewTek was formed by former staffers of Tektronix Australia to promote the range of Tektronix test and measurement products, continuing the excellent acceptance of the strong brand of Tektronix.

"The establishment of NewTek Sales Pty Ltd by former staff members of Tektronix Australia will allow a seamless transition of customer knowledge and follow through of current opportunities," said Peter Roan, the founding Managing Director. "It is very important from Tektronix management's point of view that minimum disruption occur to valued customers," said Roan.

All Tektronix products formerly sold by Tektronix Australia will be available from the new distributor.

Directors of the new company include Alan Richards who is assuming responsibility for promotion of the telecomms products and Des Harrison is managing the video products.

Another new (associated) company, NewTek Support Pty Ltd, has been formed to provide service and calibration for all Tektronix products, including older and obsolete models which Tektronix Australia did not cover.

NewTek Sales and NewTek Support will operate from premises in North Ryde, Sydney.

Contact:
NewTek Sales Pty Ltd
33 Paul St, North Ryde NSW 2113
Phone: (02) 9888 0100
Fax (02) 9888 0125
Website: www.newteksales.com
www.newteksupport.com

Central Coast Field Day

One last reminder: February 24th is the date for the Central Coast Amateur Radio Club's annual Field Day at Wyong, NSW.

You can view, participate in, listen to, buy, swap and sell all facets of amateur radio, CB radio, shortwave listening and scanning, computer communications, project building, vintage and historical displays and of course, the famous flea market, disposals areas (truckloads of pre-loved equipment!) and trade/commercial shows.

Throughout the day there will be seminars and workshops covering many interesting subjects.

For more information call 02 4340 2500 or visit www.ccarc.org.au.

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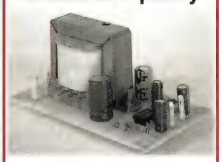

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Quick-Mark: the answer to a labelling dilemma?

Many readers produce their own PC boards but often come unstuck when it comes to professional-looking labels and panels.

Now you can make your own labels and signs by photographic transfer, without messy developing chemicals. Quick-Mark is a range of presensitised imaging film and pre-coated base sheets. It is ideal for making front panels for use in prototypes or low-volume runs, from computer-generated originals.

It is exposed to UV light through artwork, then peeled apart giving both a positive and negative image. One or other is then laminated to a self-adhesive Quick-Mark base sheet.

An optional over-lamination film can be applied for further protection or to change the appearance of the panel. This film is available in gloss, matte or Lexan polycarbonate finish.

Possible colour combinations are extensive with seven imaging film colours, nine plastic base sheet colours and two aluminium base sheets, including gold anodised. The material is supplied in 305 x 508mm sheets, which can be cut to size before processing.

The Quick-Mark materials are available through Computronics Corporation, the same people who supply the Kinsten do-it-yourself PC board materials (see SILICON CHIP, March 2001 for more information on making your own PC boards).

If the Quick-Mark system works half as well as the Kinsten system (and we hope to have an article on this subject

in the next couple of months) then the problem of making your own panels, labels and signs has been well and truly solved. Stay tuned for further details!

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Knock knock . . . I know who's there!

With this Video Intercom System from Jaycar Electronics you can see who's at the door or even the front gate before you let them in!

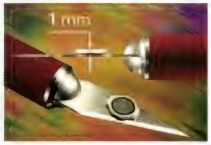
The system consists of a small external unit which houses a black & white CCD camera, speaker & microphone. It also has built-in infrared illumination to let you see visitors at night.

The internal unit houses the 4-inch monitor, handset and control buttons. The intercom doubles as a doorbell. When a visitor presses the button the bell sounds and the monitor switches on. You can then talk to the caller and can even unlock the door remotely with the optional electric door strike. The system includes a 10 metre long interconnecting cable and plugpack power supply.

With a recommended retail price of $269, the Cat QC-3412 Video Intercom System is available at all Jaycar Electronics stores and through their mail order and on-line ordering services.

Contact:
Jaycar Electronics
100 Silverwater Rd, Silverwater NSW 2128
Phone: (02) 9741 8555
Fax (02) 9741 8500
Website: www.jaycar.com.au

New 1mm thick inductors: "world's thinnest"



Coilcraft has introduced a range of "Power Wafer" inductors which are claimed to have the world's lowest profile: just 1mm thick and a footprint of 6.6 x 5.5mm.

They are said to be ideal for size-critical applications such as PC cards, PDAs, notebook computers, mobile phones and other handheld products.

There are 16 models in the series, with inductance ranging from 1μH to 330μH and current ratings up to 3.6A rms.

Designers can obtain an evaluation kit containing all 16 values via the company's website.

Contact:
Coilcraft Europe
21 Napier Place, Wardpark North, Cumbernauld, Scotland G68 0LL
Phone: +44 1236 730627
Website: www.coilcraft.com

Nilsen's "SITEPRO" UPS

For mission-critical applications, Nilsen Technologies has a range of true voltage and frequency-independent Uninterruptible Power Supplies ranging from 10 - 40kVA.

Rated at unity power factor and with redundant parallel architecture, the SITEPRO is said to deliver more active power than any other UPS on the market and to be the most cost efficient and reliable UPS available.

The SITEPRO units measure 680 x 800 x 1450mm and, with standard batteries, weigh between 380 and 750kg, depending on the model.

Contact:
Nilsen Technologies
Phone: 1800 623 350
Fax: 1800 067 263
Website: www.nilsen.com.au

Want a battery? Here's great value!

We spotted this in our local DSE store just before Christmas and thought at the time, "What a great idea!"

It's a re-usable plastic storage case (a la a tool box) which contains a useful range of alkaline batteries – 12 x AA, 8 x AAA, 6 x C and 4 x D size. You'll never run out of batteries again!

The batteries are DSE's own "Digitor" brand, suitable for a wide range of high-drain electronic equipment. They contain no added mercury.

Purchased separately, the price of the batteries alone would be sure to exceed the $39.47 price tag – and you get the case/toolbox thrown in.

The Digitor Alkaline Battery Pack is available from all Dick Smith Electronics stores, DSE PowerHouse stores, via mail order or through the DSE website.

Contact:
Dick Smith Electronics
2 Davidson St, Chullora NSW 2190
Ph: 02 9642 9100 Fax: 02 9642 9153
website: www.dse.com.au

Motorcycle Alarm kits now available

We have been advised by Mick Gergos, the author of the Motorcycle Alarm (SILICON CHIP January 2002) that he now has kits for this project available.

The kit includes the pre-programmed microprocessor, PC board and a quality non-position sensitive shock sensor. It does not include the siren as this is dependent on the type of 'bike and room available for mounting. Price of the kit is $49.50(inc GST) plus $5.00 P&P.

Contact:
Mick Gergos
13 Bunya St,
Bushland Beach, Qld 4818
email: micwen@tpg.com.au

You wouldn't read about it . . .

The things we do: tall tales – but true!

Then there was the reader who called about a project he was building. During the conversation he revealed he was deaf in one ear – ever since he lost his $2500 hearing aid.

"Lost", we asked?

"Yeah, well a few weeks ago I'd had a couple too many so decided to go to bed early. I took me hearing aid out and placed it on the bedside table. Then I remembered I'd forgotten to take me pills – big buggers, they are too. Except this night I recall thinking they were a bit bigger than I remembered. Mebbe two were stuck together. I put it down to the grog, except I was darned if I could find me hearing aid next morning . . ."

And what about this one (it's not original – it came off a newsgroup – but we've just gotta tell it!): the bloke who decided to upgrade his computer CPU – a Celeron (socket 370) to an Athlon XP1900.

Just in case you didn't know, the Athlon has more pins than a Celeron: a lot more.

Try as he might, this poor guy couldn't get the new chip to fit the Socket 370. And that was even after trying to bash it into submission. Literally bash it!

So what did our resourceful chap do? Simple: he just carefully cut off all those "excess" pins which wouldn't fit into the socket holes. Ahh, now it fitted.

No, the chip was not covered by warranty . . .

IN YOUR NEXT * SILICON CHIP

High Power 12V Amp

Would you believe 50W output from a 12V supply? It's easy to build, too . . .

Itty Bitty USB Lamp

Need some light? Nifty, bright little lamp plugs into your computer's USB port. Simple!

6-Channel Infrared Volume Controller

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RIAA preamp for modern amplifiers

Most modern amps don't have a "phono" input. But many people still want to play those old records . . .

**** These projects are currently planned for March Silicon Chip, due on sale 27/02/02. Issue content may vary by press time.***

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Part#: WSTA6

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LOOK MA – NO KEYBOARD!

Want to boot a PC without a keyboard but it refuses unless the keyboard is connected? You can usually overcome this problem by altering a BIOS setting but not all BIOSes let you do that. Here's a simple low-cost way to "fake" the keyboard and make the PC boot.

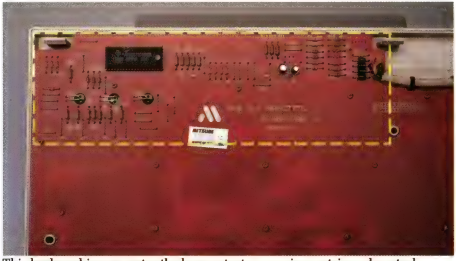
By GREG SWAIN

There are many situations where it's convenient to have a PC running without a keyboard or monitor connected. For example, you might have a network PC that functions as a dedicated Internet gateway or as a file and printer server. Or perhaps you have an old PC that controls a watering system or security lights around your home.

In those cases, you usually leave the PC running continuously – perhaps stacked on a shelf or tucked out of sight in a cupboard or in the garage. And because the machine isn't being accessed, you don't want a keyboard or monitor hogging valuable space.

Nearly all PCs will boot without a monitor but will "hang" if there's no keyboard. Fortunately, that's usually easy to fix – just go to the main menu in the BIOS setup and change the "Halt On [All Errors]" setting to "Halt On [No Errors]".

That way, when the machine starts to boot, it will ignore any errors that are detected during the boot process, such as a missing keyboard.



This keyboard incorporates the key contacts, scanning matrix and control circuitry all on one large PC board. In this case, it's just a matter of cutting out the control circuitry (inside the dotted yellow line) and discarding the rest.

The BIOS is usually accessed by pressing the "Delete" key when prompted, just after the computer has completed its POST (Power-On Self Test) routine. In some cases, however, you have to press the F1 key or some other key to access the BIOS, although this is usually confined to older machines.

No BIOS setting

OK, that's the easy way of doing it. But what if no "Halt On" setting is included in the system BIOS, as in some older (and not so old) machines? In that case, the only way around the problem – short of hanging a real keyboard out the back – is to use a "dummy" keyboard.

It's quite simple really – just obtain a defunct keyboard, "rat" the electronic circuit board from it, whack it in a small case complete with the cable, plug it into the PC and Bob's your aunt. The bulky keyboard that you were hoarding "just in case it came in handy" can then be chucked in the bin (where it really belongs).

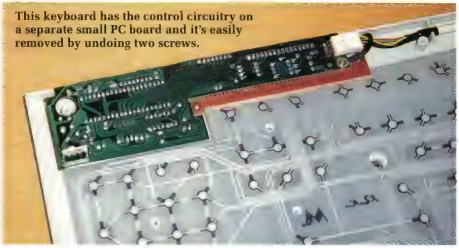
As long as the PC "sees" the relevant return codes from the keyboard circuitry, it will think that a real keyboard has been connected and will boot up.

Of course, this assumes that the circuitry itself is OK. Fortunately, this is almost always the case – it's the key contacts that usually fail. Either that, or the keyboard becomes so grotty and full of muck that it's replaced rather than cleaned.

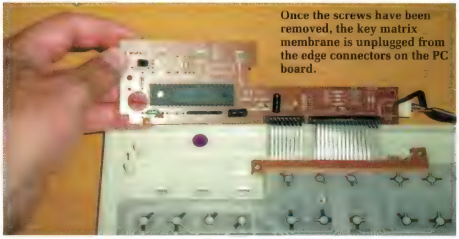
By the way, the "dummy" keyboard idea isn't ours. We originally saw it posted on the local **aus.electronics** newsgroup by Franc Zabkar and pinched it – with Franc's blessing.

Removing the PC board

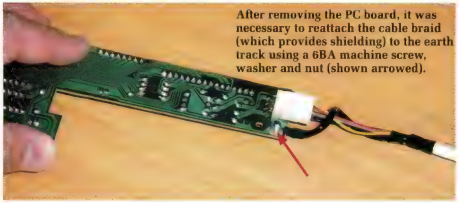
Usually, the circuit board is quite



This keyboard has the control circuitry on a separate small PC board and it's easily removed by undoing two screws.



Once the screws have been removed, the key matrix membrane is unplugged from the edge connectors on the PC board.



After removing the PC board, it was necessary to reattach the cable braid (which provides shielding) to the earth track using a 6BA machine screw, washer and nut (shown arrowed).

compact (it's invariably based on a single chip) and it has an edge connector for a key matrix membrane. You don't need any of the keys, so it's just a matter of removing the keyboard back, undoing a couple of screws to remove the circuit board and unplugging the key matrix membrane. The NUM Lock, Caps Lock and Scroll Lock indicator LEDs can also be removed.

You should be left with the circuit board itself plus the cord that's connects it to the PC. This can then be housed in a small plastic case, fitted into a plastic tube or, if it's small enough, encapsulated in some heat-shrink tubing.

Any excess cord can either be stuffed into the case with the circuit board or neatly coiled up and secured with tape or cable ties.

The board's too big

Instead of a key-contact membrane, many early keyboards were based on

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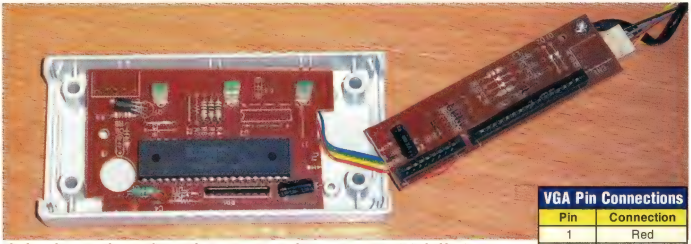


The board was too long to fit into the case we wanted to use, so we cut it in half using a hacksaw (cunning, what?). The two sections were then joined using rainbow cable. Note that we only needed a 4-way cable for this – the tracks running off to the edge connectors for the key matrix aren't required, so they don't need to be joined.

one large PC board which included all the circuitry plus the key contacts and scanning matrix – see photo. In this case, it's simply a matter of using a hacksaw to cut away the wanted section containing just the electronics.

It's really just a matter of using your commonsense as to what you keep. Obviously, you need to keep the chip plus all the circuitry (including the supply tracks) between it and the cord. You don't need anything that runs off to the keys or to the indicator LEDs. If an AT/XT switch is present, leave it in place and switch it to the AT position.

Practising what's preached

To demonstrate how easy it all is, we ratted an old AT/XT keyboard. Its circuit board proved a bit too long for the small case that we wanted to use so we cut it in half using a hacksaw and then joined the two halves using some rainbow cable.

This allowed the two halves to be folded over and squashed into the case, with some heatshrink tubing over one section to prevent shorts. A slot cut into one of the case ends provided the exit for the cord which was neatly coiled up and secured with a few cable ties.

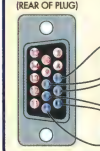


Fig.1: three 75Ω resistors wired to the back of a DB15 VGA plug is the cure if the PC won't boot without a monitor.

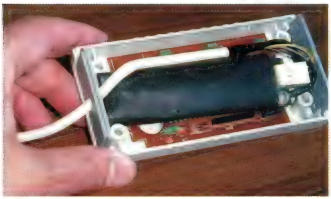
What about a monitor?

It's only rare that not having a monitor causes boot problems but some old VGA video cards (eg, Trident) can be fussy. Franc Zabkar's suggestion here is to connect three 75Ω resistors between each of the RGB outputs and their respective grounds.

The above table shows the pinouts for the VGA connector, while Fig.1 shows how the three resistors are wired across the back of the plug. You can pick up a DB15 VGA plug (plus plastic shell) from an electronics supplier for a few dollars or scrounge one for "nix" from a defunct monitor. **SC**

VGA Pin Connections

Pin	Connection
1	Red
2	Green/Mono
3	Blue
4	-
5	-
6	R-Gnd
7	G-Gnd
8	B-Gnd
9	-
10	Gnd
11	Gnd (Colour)
12	-
13	Hor. Sync
14	Vert. Sync
15	-



The thin section of board was insulated using heatshrink tubing and "folded" back over the main section. The cord exits through a slot cut into one end of the case.

At 120 x 60 x 28mm, the dummy keyboard is a lot smaller than the real thing. It can be affixed to the back of the PC (eg, using Velcro) or perhaps even hidden inside the PC.

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Type supplied may differ from the one shown.

(NEW) 40X2 Hyundai LCD's

These 40*2 LCD module are new and manufactured by Hyundai. Standard Hitachi chipset. No backlight. PCB size is 180mm x 35mm Check the following website for more information: http://www.allamerican.com/direct/results.asp?SHOW=50&MFG=_HYNL_ $25 each (limited quantity)

(NEW) 20X2 LCD BACKLIT DISPLAY:

Optrex #DMC20059, (data is available for similar 20 x 2 displays). 6mm x 8mm characters, 122mm wide x 30mm high. PCB dimensions 151mm wide x 56mm high. Uses standard Hitachi chipset (HD44780) with LED back-light (DL8.) $11 each or 3 for $27

(NEW) OPTO 22 Relay I/O Module

Relays by APTech in Japan. AC Output is 24-280 VAC, with 5 VDC Logic. Check for more information at:. http://www.opto22.com/Ordering/ProductDrillDown.asp?IK=182\ $8 each

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CLOCK / CALENDAR KIT:

This kit is a 12 hour clock can also be used as a timer. Features include large (13mm) Green LED display, AM-PM LED, Date, Month, 24 hour Alarm, 59 minute sleep timer & Back- up battery. Kit is crystal controlled to 50Hz (20ms) so it can also be used for CRO calibration & inverters. Can switch an external load during the alarm or timer (0.5A load directly or 10A with an additional mosfet). Alarm piezo speaker provided. Operates from 12V DC. PCB & all on-board components kit. (K136) $15

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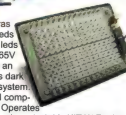
For Night Viewers or CCD Cameras using 140 of our 880nm / 40° IR leds which have 35mW output. These leds have a forward voltage drop of 1.65V & a water clear lens. The kit uses an LDR and switches on when it gets dark or can be controlled by an alarm system. Kit includes PCB and all on-board components. The case is not supplied. Operates from 12V DC and consumes approximately 1.4A. KIT WITH 35 LEDS: (K138) $25 - KIT PRICE WITH 140 LEDS: (K138C) $67



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AS REVIEWED IN THIS MAGAZINE

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Output Power: 92 dB SPL at 5m listening position...
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Weight: 1.5Kg per speaker set including adapter...
Dimension: 153X101X114mm...(GCS300): $22 - limited quantity.

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Tektronix K1205 Protocol Analyser:

This Portable unit (1219MH1) is in excellent condition and it looks like it has never been used before. This Protocol Tester comes with basic software (which include Microsoft WindowsNT) for monitoring application, unlimited license for monitoring links, Celeron CPU, user manual and bunch of cables. Complete with VGA-compatible colour screen, keyboard and disk drive. Interfaces include SCSI, Ethernet for 10Base-2 and 10Base-T, two serial ports and one parallel port. It also has an E1/DS1 Interface Board PRIME for Narrowband Interfaces. This Protocol Analysers provide powerful monitoring tools for your signalling network. Dimension: 370mm 290mm 200mm. Weight: 20kg (with the case). Check the following website for more information: http://www.tektronix.com. $ 12200 (1 only)

(Used) The Citizen iDP3530 Printer:

These Printers are in excellent condition and are made in Japan. They come with basic software, a Brand New Paper roll and a Ribbon. The Citizen printer is a rugged Point of Sale Printer with a serial interface. It is capable of being used on a wide variety of hardware platforms, not confined to a standard PC. This opens up a range of other uses, such as capturing call details on a PABX, logging data from a Weather Station or recording the performance of a Solar Water Heater. Any equipment with a standard RS232 port is capable of utilising this printer. $99

$99

(NEW) HYUNDAI FLASH MEMORY IC

Organized as 512K x 8 bits. The 32pin surface mount HY29F040 IC has been assembled on a larger PCB that has 0.1" pin spacing (32 pins in total): (GMEM1) $6 each

(NEW) UPS12-310 High Rate Series Batteries:

These are Valve Regulated Lead Acid Batteries for UPS Standby Power Applications. These are around 2 years old but in very good condition. 12V (6 Cells/unit), Capacity is 88AH @ 20 hr rate and 330 watts/cell @ 15 min. rate. (Some 100AH available POA). These batteries features Flame-arresting one-way pressure-relief vent , thermally shielded case-to-cover bond to eliminate leakage, multicell design for economy of installation & maintenance and can be mounted in any orientation.
Dimensions 300mm 170mm 210mm.
Weight 30 kg. Check for more information at: http://www.powerfactoring.com/Batteries/johnson_control.htm. $ 99 **(limited quantity)**

SOLAR REGULATOR KIT: (Intelligent Charger).**CLEARANCE!!!**

Designed to efficiently charge 12 - 24V up to 16A batteries from solar panels, can also be used in with existing simple car battery chargers (such as the common Arlec 4A chargers) to prevent overcharging. Simply turns off the charging current when the battery float voltage is exceeded, turns on when the battery voltage drops a preset amount below the float voltage. Easily modified for higher currents. Has negligible standby current. PCB: 149 x 66mm. PUBLISHED: EA Nov / Dec94 (K009) $20

BATTERY MANAGEMENT SYSTEM KIT:

This kit can be configured to measure 12V or 24V batteries. Features include low voltage cut-out & an audible alarm before cut-out. This monitor is designed to use minimal power & has a battery saving 12 led bar-graph indicator. This kit can be used to monitor power & battery levels in a car, boat, caravan or home. Kit includes PCB, all on-board components & a paper label. The plastic case is not supplied. PUBLISHED: EA Magazine February 2000. KIT PRICE: (K141) $32

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VINTAGE RADIO

By RODNEY CHAMPNESS, VK3UG

The Diason P.P. 32/6 DC receiver

Designed for rural communities, the Diason P.P.32/6 employed six valves and ran off 32V DC. It was a good performer with some interesting design features.

Many will not know the Diason brand, as Diason Radio was a small family company and was not a major player in the 1950s domestic marketplace. They produced a couple of portable receivers, one exclusively battery operated and another a battery/AC model in 1950. In addition, they produced three DC-powered receivers – the 32/6, 50/6 and 110/6 – in the same year.

The 32/6 and 50/6 were virtually identical except for the way the heaters were wired in these 32V and 50V DC receivers. The 110V (model 110/6) receiver used the same heater wiring circuitry as the 50/6 but employed 12V heater series valves instead of the 6V series. For example, a 12SK7 was used in lieu of a 6SK7, while the audio output valve was a 50L6 instead of a 25L6. The high tension (HT) to the plates and screens came directly from the supply voltage, as was common with some Astor 32V receivers.

Just how well these near identical receivers worked would be interesting to know. The gain of each stage with 32V HT would not be very high, so even with a radio frequency (RF) stage and two intermediate frequency (IF) stages, the set would have been quite stable despite the minimal use of decoupling throughout the set.

With higher voltages, the gain would have increased and I suspect that the higher voltage sets could be quite unstable. Additionally, the bias on the 25L6 (50L6 in 110V set) was only -1.5V, as supplied by a dry cell.

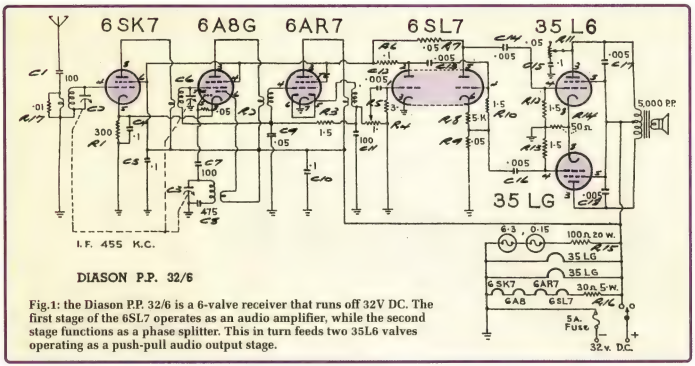


Fig.1: the Diason P.P. 32/6 is a 6-valve receiver that runs off 32V DC. The first stage of the 6SL7 operates as an audio amplifier, while the second stage functions as a phase splitter. This in turn feeds two 35L6 valves operating as a push-pull audio output stage.

On 32V, this would have been quite adequate but with 110V on the plate and screen of the 50L6, the bias should have been -7.5V.

In the standard format that is shown in the Australian Official Radio Service Manual (AORSM) Volume 9 for 1950, I believe the higher voltage sets would have been absolute disasters. For this reason, I suspect that either no 50V or 110V sets were produced or if they were, the circuit was altered to overcome the problems of the higher voltage supply.

A worthy successor

The successor to the 32/6 (50/6 and 110/6) receiver was the interesting 32V DC-operated P.P.32/6 model of 1953. This set overcame the very real faults that were evident in the previous models. Some time ago, I had an opportunity to examine one of these later sets, which belonged to Ralph Robertson, a fellow member of the Vintage Radio Club in northeast Victoria.

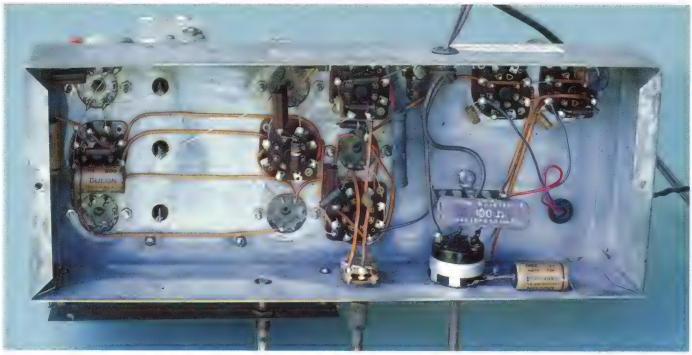
It is noticeably better in design than the earlier models and there is no sign of instability – just good performance. It uses a 6SK7 RF stage, a 6A8G converter and a 6AR7 IF amplifier and detector. This then drives a 6SL7 audio amplifier and phase splitter, which in turn feeds two 35L6 valves operating as a push-pull audio output stage.

This general circuit layout is inherently quite stable with a low HT supply, as the gain of each individual stage is relatively low. There is some gain at RF frequencies, some at the converter and some at the IF frequency. However, the receiver does not have a lot of gain within any one frequency range, although the total gain throughout the receiver when the gain of all stages is totalled up is quite significant.

The chassis is easily removed from the cabinet for service, although the loudspeaker also has to be removed since its leads are too short.

The low-level audio stages have quite reasonable gain and feed the push-pull 35L6 valves. A single class-A 35L6 would be struggling to provide enough audio output to satisfy listeners, since the output would only be in the order of 100-150mW. With two push-pull valves, the audio output is more than doubled.

Radio Corporation's Astor receivers also used two 25L6 valves (similar to the 35L6) operating in push-pull in



This under-chassis view shows just how few components there are. This made for a reliable set that's very easy to work on.

the audio output stages of their 32V HT receivers.

Restoring the PP 32/6

When Ralph obtained his radio, it was in rather a sorry state. The 6A8G and 6SL7 valves were missing and the loudspeaker had been damaged when someone had carelessly put the chassis back in the cabinet, putting the volume control spindle through the cone in the process. Admittedly, the set's physical layout is at fault in allowing this to occur.

The loudspeaker is attached to the cabinet and its leads are too short to allow the chassis to be withdrawn easily. Additionally, it is not practical to work on the set with the speaker in the cabinet. The leads can be extended or the speaker removed from the set to allow service as shown in the accompanying photograph (extending the leads is my preference).

After removing the chassis, both it and the inside of the cabinet were cleaned. Fortunately, this was not a particularly difficult job as there had been no rodents as house guests.

Inspection of the underside of the chassis didn't reveal any paper capacitors sufficiently leaky to warrant replacement. They must have been a good batch – either that or the low HT doesn't stress the capacitors as much as in a set with higher HT voltages. And of course, there would not be much heat generated under the chassis.

Even so, I would still replace the most critical capacitors, these being C9 and C13 in this set.

The twin power lead was fitted with a 2-pin polarised plug. It's interesting to note that many DC sets were fitted initially with the normal 3-pin mains plug and, as a result, many 32V sets have been plugged into the 240V AC mains with disastrous results. People forget that voltages other than 240V AC were often used in earlier times.

Typically, the owners of secondhand shops, eager to see if the sets work, plug them into the 240V AC. Hopefully, a fuse blows and no further damage is done.

No other components proved defective in Ralph's set so it was time to give it a test run. It was connected to a 32V DC supply but it soon became evident that the set was not well. Checking revealed that one 35L6 had no emission and a replacement soon had the audio section up and running.

The voltages around the receiver were then checked and found to be in order. So what voltages do you expect in a radio with a 32V HT supply? The plates and screens of all valves other than the 6SL7 should be 32V; the cathodes of the 6SK7 and 6A8G should be about 1V; and the cathodes of the 35L6 valves should be around 1.5V with respect to chassis. Pin 2 of the 6SL7 should be around 15-20V, pin 6 about 8V and pin 5 approximately 24V. There are no high voltages here!

Aligning the receiver

The alignment procedure for this type of set is quite straightforward. First, the IF is aligned with a signal from a generator on 455kHz. A digital multimeter (DMM) set to the 20V DC range and connected across the volume control or C9 will read higher voltages as the IF alignment is peaked. The oscillator, RF and aerial coil cores are adjusted for peak output at around 600kHz and the trimmers (not shown on the circuit diagram) are adjusted at around 1450 kHz or, in each case, on a known station near to these frequencies. Stations 3RN (3AR) on 621kHz and 2QN on 1521kHz can be used where I live.

One problem with the alignment is that the dial scale remains in the cabinet when the chassis is removed. In cases like that, I tend to close the gang and adjust the oscillator so that the receiver will tune 530kHz and then adjust it at the other end of the dial so that it will tune to 1620kHz. The dial scale itself will give you some idea of what the tuning range actually is.

To get the oscillator tracking accurately across the band, it will be necessary to put the chassis in and take it out of the cabinet a few times while doing the adjustments – a tedious job.

There's plenty of room for the chassis inside the cabinet. In this case, the twin power lead was fitted with a 2-pin polarised plug but many early DC sets were initially fitted with a 3-pin mains plug. As a result, many 32V sets have been plugged into the 240V AC mains with disastrous results.

The aerial and RF circuits can be adjusted out of the cabinet as their adjustments do not affect the accuracy of the oscillator tuning.

By the way, the latter job is made more difficult because the dial pointer is about 15mm behind the dial scale so there can be considerable parallax error.

Having completed the restoration, the set proved to be quite a good performer and is well-suited for use in country areas, away from broadcast stations.

Shortcomings and features

The set is designed to have the negative side of the 32V supply attached to the chassis. However, the fuse is in the negative line so, under some circumstances, the fuse could blow and the set would still be supplied via the set's earth system (assuming that one side of the 32V supply was earthed). It would have been a better idea to have placed the fuse in the positive line.

Having said that, one interesting feature is the use of C1. This capacitor would prevent "burn out" of the aerial coil if the antenna fell across the live +32V line from the lighting plant (most 32V supplies on farms used bare overhead cables).

It is odd that incorrect component values are often used in receivers. The series dropping resistor for the dial lamps (R15) is 100Ω but for use on 32V, this should be 127Ω, otherwise the dials lamps will each have more than 6.3V across them. What's more, a

Photo Gallery: Astor Model JN

Manufactured by Radio Corporation (Melbourne) in 1948, the Astor Model JN is a 6-valve dual-wave superhet housed in a substantial Bakelite cabinet and fitted with an 8-inch (200mm) loudspeaker. The combination of the large loudspeaker and an effective loudness compensation circuit around the volume control resulted in good audio performance, for which Astor sets were renowned. The set was fitted with the following valves: 6U7-G RF amplifier; 6J8-G frequency changer; 6U7-G IF amplifier; 6B6-G first audio/detector/AVC rectifier; 6V6-G output; and 5Y3-F rectifier. (Photo and information courtesy of Historical Radio Society of Australia).

AWA TEACHING AID

Made by AWA during the 1960s, this device was designed to teach radio technology students how valves worked. The valve envelopes were large so that students could easily see the various parts that made up the two valves (one a triode, the other a CRT) on top of the chassis.

32V set of batteries on charge can reach 40V, so even 127Ω is too low . In fact, R15 should be around 180Ω. And although a 20W resistor is used, a 10W unit would be quite adequate for the job.

Conversely, R16 should be lower at around 23Ω for use off 32V. However, most better quality 32V sets used a 3-position power switch instead of the 2-position switch used in this set. The first position was "off, while the second position was "charge". In the latter case, a resistor was switched in series with the supply to drop the voltage to the valve filaments to around 32V when the batteries were on charge. However, with the set connected to a set of charging batteries it doesn't matter if the valve plates and screens do get 40V – they'll just perform more effectively.

The third position of the power switch was "on", where the 32V was connected directly to the valves.

There are no trimmer capacitors shown on the circuit but they are fitted nonetheless. The fixed capacitors inside the IF transformers are not shown either and neither are the adjustment cores for the IF transformers or the front-end coils.

Another oddity is that the circuit shows the set as having one 35L6 valve in the output and one 35LG. The latter is simply a drafting error – the valve is in reality a 35L6. The valves probably all had the suffix GT.

At this stage, the cabinet has not been restored although it has been cleaned. The cabinet itself is quite light, being made of relatively thin veneered plywood.

Summary

The set is a good performer and was quite suitable for use by the farming community. However, I suspect that it would have been prone to picking up commutator whine from the 32V lighting plant when it was charging batteries or, for that matter, from any small motor attached to the 32V supply. That's because there is absolutely no filtering of the 32V rail before it is applied to the valve plates and screens, other than for the 6SL7.

However, the set works well when powered from a 32V DC filtered power supply (eg, as described on p88 of the January 2001 issue). If you like collecting 32V sets, this one deserves a place in your collection. **SC**

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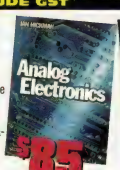

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December 1993: Remote Controller For Garage Doors; Build A LED Stroboscope; Build A 25W Audio Amplifier Module; A 1-Chip Melody Generator; Engine Management, Pt.3; Index To Volume 6.

January 1994: 3A 40V Variable Power Supply; Solar Panel Switching Regulator; Printer Status Indicator; Mini Drill Speed Controller; Stepper Motor Controller; Active Filter Design; Engine Management, Pt.4.

February 1994: Build A 90-Second Message Recorder; 12-240VAC 200W Inverter: 0.5W Audio Amplifier; 3A 40V Adjustable Power Supply; Engine Management, Pt.5, Airbags In Cars – How They Work.

March 1994: Intelligent IR Remote Controller; 50W (LM3876) Audio Amplifier Module; Level Crossing Detector For Model Railways; Voice Activated Switch For FM Microphones; Engine Management, Pt.6.

April 1994: Sound & Lights For Model Railway Level Crossings; Discrete Dual Supply Voltage Regulator; Universal Stereo Preamplifier; Digital Water Tank Gauge; Engine Management, Pt.7.

May 1994: Fast Charger For Nicad Batteries; Induction Balance Metal Locator; Multi-Channel Infrared Remote Control; Dual Electronic Dice; Simple Servo Driver Circuits; Engine Management, Pt.8.

June 1994: 200W/350W Mosfet Amplifier Module; A Coolant Level Alarm For Your Car; 80-Metre AM/CW Transmitter For Amateurs; Converting Phono Inputs To Line Inputs; PC-Based Nicad Battery Monitor; Engine Management, Pt.9.

July 1994: Build A 4-Bay Bow-Tie UHF TV Antenna; PreChamp 2-Transistor Preamplifier; Steam Train Whistle & Diesel Horn Simulator; 8V SLA Battery Charger; Electronic Engine Management, Pt.10.

August 1994: High-Power Dimmer For Incandescent Lights; Microprocessor-Controlled Morse Keyer; Dual Diversity Tuner For FM Microphones, Pt.1; Nicad Zapper (For Resurrecting Nicad Batteries); Electronic Engine Management, Pt.11.

September 1994: Automatic Discharger For Nicad Battery Packs; Mini/Vox Voice Operated Relay; Image Intensified Night Viewer; AM Radio For Weather Beacons; Dual Diversity Tuner For FM Microphones, Pt.2; Electronic Engine Management, Pt.12.

October 1994: How Dolby Surround Sound Works; Dual Rail Variable Power Supply; Build A Talking Headlight Reminder; Electronic Ballast For Fluorescent Lights; Electronic Engine Management, Pt.13.

November 1994: Dry Cell Battery Rejuvenator; Novel Alphanumeric Clock; 80-Metre DSB Amateur Transmitter; Twin-Cell Nicad Discharger (See May 1993); How To Plot Patterns Direct to PC Boards.

December 1994: Easy-To-Build Car Burglar Alarm; Three-Spot Low Distortion Sinewave Oscillator; Clifford – A Pesky Electronic Cricket; Remote Control System for Models, Pt.1; Index to Vol.7.

January 1995: Sun Tracker For Solar Panels; Battery Saver For Torches; Dolby Pro-Logic Surround Sound Decoder, Pt.2; Dual Channel UHF Remote Control; Stereo Microphone Preamplifier.

February 1995: 2 x 50W Stereo Amplifier Module; Digital Effects Unit For Musicians; 6-Channel Thermometer With LCD Readout; Wide Range Electrostatic Loudspeakers, Pt.1; Oil Change Timer For Cars; Remote Control System For Models, Pt.2.

March 1995: 2 x 50W Stereo Amplifier, Pt.1; Subcarrier Decoder For FM Receivers; Wide Range Electrostatic Loudspeakers, Pt.2; IR Illuminator For CCD Cameras; Remote Control System For Models, Pt.3.

April 1995: FM Radio Trainer, Pt.1; Photographic Timer For Darkrooms; Balanced Microphone Preamp. & Line Filter; 50W/Channel Stereo Amplifier, Pt.2; Wide Range Electrostatic Loudspeakers, Pt.3; 8-Channel Decoder For Radio Remote Control.

May 1995: Build A Guitar Headphone Amplifier; FM Radio Trainer, Pt.2; Transistor/Mosfet Tester For DMMs; A 16-Channel Decoder For Radio Remote Control; Introduction to Satellite TV.

June 1995: Build A Satellite TV Receiver; Train Detector For Model Railways; 1W Audio Amplifier Trainer; Low-Cost Video Security System; Multi-Channel Radio Control Transmitter For Models, Pt.1.

July 1995: Electric Fence Controller; How To Run Two Trains On A Single Track (Incl. Lights & Sound); Setting Up A Satellite TV Ground Station; Build A Reliable Door Minder.

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August 1995: Fuel Injector Monitor For Cars; Gain Controlled Microphone Preamp; Audio Lab PC-Controlled Test Instrument, Pt.1; How To Identify IDE Hard Disk Drive Parameters.

September 1995: Railpower Mk.2 Walkaround Throttle For Model Railways, Pt.1; Keypad Combination Lock; The Vader Voice; Jacob's Ladder Display; Audio Lab PC-Controlled Test Instrument, Pt.2.

October 1995: 3-Way Loudspeaker System; Railpower Mk.2 Walkaround Throttle For Model Railways, Pt.2; Build A Fast Charger For Nicad Batteries; Digital Speedometer & Fuel Gauge For Cars, Pt.1.

November 1995: Mixture Display For Fuel Injected Cars; CB Transverter For The 80M Amateur Band, Pt.1; PIR Movement Detector; Digital Speedometer & Fuel Gauge For Cars, Pt.2.

December 1995: Engine Immobiliser; 5-Band Equaliser; CB Transverter For The 80M Amateur Band, Pt.2; Subwoofer Controller; Knock Sensing In Cars; Index To Volume 8.

January 1996: Surround Sound Mixer & Decoder, Pt.1; Magnetic Card Reader; Build An Automatic Sprinkler Controller; IR Remote Control For The Railpower Mk.2; Recharging Nicad Batteries For Long Life.

April 1996: Cheap Battery Refills For Mobile Phones; 125W Audio Amplifier Module; Knock Indicator For Leaded Petrol Engines; Multi-Channel Radio Control Transmitter; Pt.3.

May 1996: Upgrading The CPU In Your PC, High Voltage Insulation Tester; Knightrider Bi-Directional LED Chaser; Simple Duplex Intercom Using Fibre Optic Cable; Cathode Ray Oscilloscopes, Pt.3.

June 1996: BassBox CAD Loudspeaker Software Reviewed; Stereo Simulator (uses delay chip); Rope Light Chaser; Low Ohms Tester For Your DMM; Automatic 10A Battery Charger.

July 1996: Build A VGA Digital Oscilloscope, Pt.1; Remote Control Extender For VCRs; 2A SLA Battery Charger; 3-Band Parametric Equaliser; Single Channel 8-Bit Data Logger.

August 1996: Introduction to IGBTs; Electronic Starter For Fluorescent Lamps; VGA Oscilloscope, Pt.2; 350W Audio Power Amplifier Module; Masthead Amplifier For TV & FM; Cathode Ray Oscilloscopes, Pt.4.

September 1996: VGA Oscilloscope, Pt.3; IR Stereo Headphone Link, Pt.1; High Quality PA Loudspeaker; 3-Band HF Amateur Radio Receiver; Cathode Ray Oscilloscopes, Pt.5.

October 1996: Send Video Signals Over Twisted Pair Cable; Power Control With A Light Dimmer; 600W DC-DC Converter For Car Hifi Systems, Pt.1; IR Stereo Headphone Link, Pt.2; Build A Multi-Media Sound System, Pt.1; Multi-Channel Radio Control Transmitter, Pt.4.

November 1996: 8-Channel Stereo Mixer, Pt.1; Low-Cost Fluorescent Light Inverter; Repairing Domestic Light Dimmers; Multi-Media Sound System, Pt.2; 600W DC-DC Converter For Car Hifi Systems, Pt.2.

December 1996: Active Filter Cleans Up Your CW Reception; A Fast Clock For Railway Modellers; Laser Pistol & Electronic Target; Build A Sound Level Meter; 8-Channel Stereo Mixer, Pt.2; Index To Volume 9.

January 1997: How To Network Your PC; Control Panel For Multiple Smoke Alarms, Pt.1; Build A Pink Noise Source; Computer Controlled Dual Power Supply, Pt.1; Digi-Temp Monitors Eight Temperatures.

February 1997: PC-Controlled Moving Message Display; Computer Controlled Dual Power Supply, Pt.2; Alert-A-Phone Loud Sounding Telephone Alarm; Control Panel For Multiple Smoke Alarms, Pt.2.

March 1997: Driving A Computer By Remote Control; Plastic Power PA Amplifier (175W); Signalling & Lighting For Model Railways; Build A Jumbo LED Clock; Cathode Ray Oscilloscopes, Pt.7.

April 1997: Simple Timer With No ICs; Digital Voltmeter For Cars; Loudspeaker Protector For Stereo Amplifiers; Model Train Controller; A Look At Signal Tracing, Pt.1; Cathode Ray Oscilloscopes, Pt.8.

May 1997: Neon Tube Modulator For Light Systems; Traffic Lights For A Model Intersection; The Spacewriter – It Writes Messages In Thin Air; A Look At Signal Tracing; Pt.2; Cathode Ray Oscilloscopes, Pt.9.

June 1997: PC-Controlled Thermometer/Thermostat; TV Pattern Generator, Pt.1; Audio/RF Signal Tracer; High-Current Speed Controller For 12V/24V Motors; Manual Control Circuit For Stepper Motors.

July 1997: Infrared Remote Volume Control; A Flexible Interface Card For PCs; Points Controller For Model Railways; Colour TV Pattern Generator, Pt.2; An In-car Mixer For Radio Control Receivers.

August 1997: The Bass Barrel Subwoofer; 500 Watt Audio Power Amplifier Module; A TENs Unit For Pain Relief; Addressable PC Card For Stepper Motor Control; Remote Controlled Gates For Your Home.

September 1997: Multi-Spark Capacitor Discharge Ignition; 500W Audio Power Amplifier; Pt.2; A Video Security System For Your Home; PC Card For Controlling Two Stepper Motors; Hifi On A Budget.

October 1997: Build A 5-Digit Tachometer; Add Central Locking To Your Car; PC-Controlled 6-Channel Voltmeter; 500W Audio Power Amplifier, Pt.3; Customising The Windows 95 Start Menu.

November 1997: Heavy Duty 10A 240VAC Motor Speed Controller; Easy-To-Use Cable & Wiring Tester; Build A Musical Doorbell; Replacing Foam Speaker Surrounds; Understanding Electric Lighting Pt.1.

December 1997: Speed Alarm For Cars; 2-Axis Robot With Gripper; Stepper Motor Driver With Onboard Buffer; Power Supply For Stepper Motor Cards; Understanding Electric Lighting Pt.2; Index To Vol.10.

January 1998: Build Your Own 4-Channel Lightshow, Pt.1 (runs off 12VDC or 12VAC); Command Control System For Model Railways, Pt.1; Pan Controller For CCD Cameras; Build A One Or Two-Lamp Flasher; Understanding Electric Lighting, Pt.3.

February 1998: Multi-Purpose Fast Battery Charger, Pt.1; Telephone Exchange Simulator For Testing; Command Control System For Model Railways, Pt.2; Build Your Own 4-Channel Lightshow, Pt.2.

April 1998: Automatic Garage Door Opener, Pt.1; 40V 8A Adjustable Power Supply, Pt.1; PC-Controlled 0-30kHz Sinewave Generator; Build A Laser Light Show; Understanding Electric Lighting, Pt.6.

May 1998: Troubleshooting Your PC, Pt.1; Build A 3-LED Logic Probe; Automatic Garage Door Opener, Pt.2; Command Control For Model Railways, Pt.4; 40V 8A Adjustable Power Supply, Pt.2.

June 1998: Troubleshooting Your PC, Pt.2; Understanding Electric Lighting, Pt.7; Universal Mini Energy Ignition System; The Roadies' Friend Cable Tester; Universal Stepper Motor Controller; Command Control For Model Railways, Pt.5.

July 1998: Troubleshooting Your PC, Pt.3; Build A Heat Controller; 15-Watt Per Channel Class-A Audio Amplifier Module, Pt.1; Simple Charger For 6V & 12V SLA Batteries; Automatic Semiconductor Analyser; Understanding Electric Lighting, Pt.8.

August 1998: Troubleshooting Your PC, Pt.4 (Adding Extra Memory); Simple I/O Card With Automotive Relay Outputs; Build A Beat Triggered Strobe; 15-Watt Per Channel Class-A Stereo Amplifier, Pt.2.

September 1998: Troubleshooting Your PC, Pt.5 (Software Problems & DOS Games); A Blocked Air-Filter Alarm; A Waa-Waa Pedal For Your Guitar; Build A Stepper Motor Test Set-Up; Lasers, Laser Diode Safety; Laser Diode Indicator For Cars; Capacity Indicator For Rechargeable Batteries.

October 1998: Lab Quality AC Millivoltmeter, Pt.1; PC-Controlled Stress-O-Meter; Versatile Modular Loudspeaker Driver; TV Tickle Charger For Float Conditions; Adding An External Battery Pack To Your Flashgun.

November 1998: The Christmas Star; A Turbo Timer For Cars; Build A Poker Machine, Pt.1; FM Transmitter For Musicians; Lab Quality AC Millivoltmeter, Pt.2; Switching Mains Power By Radio; Understanding Electric Lighting, Pt.9; Improving AM Radio Reception, Pt.1.

December 1998: Protect Your Car With The Engine Immobiliser Mk.2; Thermocouple Adaptor For DMMs; A Regulated 12V DC Plugpack; Build Your Own Poker Machine, Pt.2; Improving AM Radio Reception, Pt.2; Mixer Module For F3B Glider Operations.

January 1999: High-Voltage Megohm Tester; Getting Started With BASIC Stamp; LED Bargraph Ammeter For Cars; Keypad Engine Immobiliser; Improving AM Radio Reception, Pt.3.

March 1999: Getting Started With Linux; Pt.1; Build A Digital Anemometer; 3-Channel Current Monitor With Data Logging; Simple DIY PIC Programmer; Easy-To-Build Audio Compressor; Low Distortion Audio Signal Generator, Pt.2; Electronic Lighting, Pt.12.

April 1999: Getting Started With Linux; Pt.2; High-Power Electric Fence Controller; Bass Cube Subwoofer; Programmable Thermostat/ Thermometer; Build An Infrared Sentry; Rev Limiter For Cars.

May 1999: The Line Dancer Robot; An X-Y Table With Stepper Motor Control, Pt.1; Three Dimensional Fence Sculpture; 20 LEDs; Build A Carbon Monoxide Alarm; Getting Started With Linux; Pt.3.

June 1999: FM Radio Tuner Card For PCs; X-Y Table With Stepper Motor Control, Pt.2; Programmable Ignition Timing Module For Cars, Pt.1; Hard Disk Drive Upgrades: Fitting The Software?

July 1999: Build A Dog Silencer; 10µH to 19.99mH Inductance Meter; Build An Audio-Video Transmitter; Programmable Ignition Timing Module For Cars, Pt.2; XYZ Table With Stepper Motor Control, Pt.3.

August 1999: Remote Modem Controller; Daytime Running Lights For Cars; Build A PC Monitor Checker; Switching Loudspeaker Protector; XYZ Table With Stepper Motor Control, Pt.4; Electric Lighting, Pt.14.

September 1999: Automatic Addressing On TCP/IP Networks; Autonomouse The Robot, Pt.1; Voice Direct Speech Recognition Module; Digital Electrolytic Capacitance Meter; XYZ Table With Stepper Motor Control, Pt.5; Peltier-Powered Can Cooler.

October 1999: Build The Railpower Model Train Controller, Pt.1; Semiconductor Curve Tracer; Autonomouse The Robot, Pt.2; XYZ Table With Stepper Motor Control, Pt.6; Introducing Home Theatre.

November 1999: Electric Lighting, Pt.15; Setting Up An Email Server; Speed Alarm For Cars, Pt.1; Multi-Colour LED Christmas Tree; Build An Intercom Status Expander; Following Loudspeaker System For Musicians; Railpower Model Train Controller, Pt.2.

December 1999: Electric Lighting, Pt.16; Build A Solar Panel Regulator; The PC Powerhouse (gives fixed +12V, +9V, +6V & +5V rails); The Fortune Finder Metal Locator; Speed Alarm For Cars, Pt.2; Railpower Model Train Controller, Pt.3; Index To Volume 12.

January 2000: Spring Reverberation Module; An Audio-Video Test Generator; Build The Picman Programmable Robot; A Parallel Port Interface Card; Off-Hook Indicator For Telephone Lines.

February 2000: Multi-Sector Sprinkler Controller; A Digital Voltmeter For Your Car; An Ultrasonic Parking Radar; Build A Safety Switch Checker; Build A Sine/Square Wave Oscillator.

March 2000: Resurrecting An Old Computer; Low Distortion 100W Amplifier Module, Pt.1; Electronic Wind Vane With Tri-LED Display; Glowplug Driver For Powered Models; The OzTrip Car Computer, Pt.1.

May 2000: Ultra-LD Stereo Amplifier, Pt.2; Build A LED Dice (With PIC Microcontroller); Low-Cost AT Keyboard Translator (Converts IBM Scan-Codes To ASCII); 50A Motor Speed Controller For Models.

June 2000: Automatic Rain Gauge With Digital Readout; Parallel Port VHF-FM Receiver; Li'l Powerhouse Switchmode Power Supply (1.23V to 40V) Pt.1; CD Compressor For Cars Or The Home.

July 2000: A Moving Message Display; Compact Fluorescent Lamp Driver; Eh-Chequa Musicians' Lead Tester; Li'l Powerhouse Switchmode Power Supply (1.23V to 40V) Pt.2.

August 2000: Build A Theremin For Really Eerie Sounds; Come In Spinner (auto messages in "morse"); Loudspeaker Protector For Cars; Controller For The Ultra-LD Stereo Amplifier; Proximity Switch For 240VAC Lamps; Structured Cabling For Computer Networks.

September 2000: Build A Swimming Pool Alarm; An 8-Channel PC Relay Board; Fuel Mixture Display For Cars, Pt.1; Protoboards – The Easy Way Into Electronics, Pt.1; Cybug The Solar Fly.

October 2000: Guitar Jammer For Practice & Jam Sessions; Booze Buster Breath Tester; A Wand-Mounted Inspection Camera, Installing A Free-Air Subwoofer In Your Car; Fuel Mixture Display For Cars, Pt.2; Protoboards – The Easy Way Into Electronics, Pt.2.

November 2000: Santa & Rudolf Chrissie Display; 2-Channel Guitar Preamplifier, Pt.1; Message Bank & Missed Call Alert; Electronic Thermostat; Protoboards – The Easy Way Into Electronics, Pt.3.

December 2000: Home Networking For Shared Internet Access; Build A Bright-White LED Torch; 2-Channel Guitar Preamplifier, Pt.2 (Digital Reverb); Driving An LCD From The Parallel Port; Build A more Clock; Protoboards – The Easy Way Into Electronics, Pt.4; Index To Vol.13.

January 2001: PC Resurrection – Transferring LPs & Tapes To CD; The LP Doctor – Clean Up Clicks & Pops, Pt.1; Arbitrary Waveform Generator; 2-Channel Guitar Preamplifier, Pt.3; PIC Programmer & TestBed; Wireless Networking.

February 2001: How To Observe Meteors Using Junked Gear; An Easy Way To Make PC Boards; Li'l Pulser Train Controller; Midi-Mate – A Midi Interface For PCs; Build The Bass Blaster – A Bass Guitar Elevated Groundplane Antenna; The LP Doctor – Clean Up Clicks & Pops, Pt.2.

March 2001: Driving Your Phone From A PC; Making Photo Resist PC Boards At Home; Big-Digit 12/24 Hour Clock; Parallel Port PIC Programmer & Combination Prototyping Board – The Easy Way Into Electronics, Pt.5; More MIDI – A Simple MIDI Expansion Box.

April 2001: A GPS Module For Your PC; Dr Video – An Easy-To-Build Video Stabiliser; A Tremolo Unit For Musicians; Minimitter FM Stereo Transmitter; Intelligent Nicad Battery Charger; Computer Tips – Tweaking Internet Connection Sharing.

May 2001: Powerful 12V Mini Stereo Amplifier; Microcontroller-Based 4-Digit Counter Modules; Two White-LED Torches To Build; PowerPak – A Multi-Voltage Power Supply; Using Linux To Share An Internet Connection, Pt.1; Computer Tips – Tweaking Windows With TweakUI.

June 2001: Fast Universal Battery Charger, Pt.1; Phonome – Call, Listen In & Switch Devices On & Off; Li'l Snooper – A Low-Cost Automatic Audio Recorder; Using Linux To Share An Internet Connection, Pt.2; A PC To Die For, Pt.1 (Building Your Own PC).

July 2001: The HeartMate Heart Rate Monitor; Do Not Disturb Telephone Timer; Pic-Isc – A Simple Alarm Clock; Fast Universal Battery Charger, Pt.2; A PC To Die For, Pt.2; Backing Up Your Email.

August 2001: Direct Injection Box For Musicians; Build A 200W Mosfet Amplifier Module; Headlight Reminder For Cars; 40MHz 6-Digit Frequency Counter; A PC To Die For, Pt.3; Using Linux To Share An Internet Connection, Pt.3.

September 2001: Making MP3s – Rippers & Encoders; Build Your Own MP3 Jukebox, Pt.1; PC-Controlled Mains Switch; Personal Noise Source For Tinnitus Sufferers; The Scooper Scanning Receiver; Microphone; Using Linux To Share An Internet Connection, Pt.3.

October 2001: A Video Microscope From Scrounged Parts; Build Your Own MP3 Jukebox, Pt.2; Super-Sensitive Body Detector; An Automotive Thermometer; Programming Flash Adaptor For Atmel Microcomputers; Building Your Own PC – One Man's Approach.

November 2001: Ultra-LD 100W RMS/Channel Stereo Amplifier, Pt.1; Neon Tube Modulator For Cars; Low-Cost Audio/Video Distribution Amplifier; Short Message Recorder Player; Computer Tips.

December 2001: Is There A Hybrid Car In Your Future?; Windows XP – What's In It For You?; Build A PIC Infrared Transceiver; Ultra-LD 100W RMS/Channel Stereo Amplifier, Pt.2; Parky Lights – An Intriguing Colour Display; PIC Fun And Games – Learning About Micros.

January 2002: Touch And/Or Remote-Controlled Light Dimmer; A Cheap 'n' Easy Motorbike Alarm; 100W RMS/Channel Stereo Amplifier, Pt.3; Build A Raucous Alarm Bell; Tracking Down Computer Software Problems; Electric Power Steering; FAQs On The MP3 Jukebox.

PLEASE NOTE: November 1997 to March 1989, June 1989, August 1989, December 1989, May 1990, February 1991, June 1991, August 1991, January 1992, February 1992, July 1992, September 1992, November 1992, December 1992, January 1993, May 1993, February 1996, March 1998 and febrary 1999 are now sold out. All other issues are presently in stock. For readers wanting articles from sold-out issues, we can supply photostat copies (or tear sheets) at $7.70 per article (includes p&p). When supplying photostat articles or back copies, we automatically supply any relevant notes & errata at no extra charge. A complete index to all articles published to date is available on floppy disk for $11 including p&p, or can be downloaded free from our web site: www.siliconchip.com.au

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Playmaster Twin 25 stereo amplifier

I am looking for the schematic diagram and or construction details for either the 25W or 40W per channel stereo amplifier brought out by "Electronics Australia" back in the late 70s. The problem is that the output transistors have shorted out. I know that one pair are 2N3055s but as for the other two, I assume they could be MJE2955 but I can't be sure. Can you help? (D. H., Launceston, Tas).

● The Playmaster Twin 25 and 40/40 amplifiers used one pair of 2N3055s in each channel. It was not a complementary symmetry design. If the output transistors have shorted out, look for other faults as well.

We can supply as photocopy of the relevant articles for $8.80 including postage.

6-LED torch has flashing fault

I have just built the 6-LED Torch kit featured in the May 2001 edition. The kit was easy to assemble and the torch worked first go, however once it has been on for a short period it starts flashing. It's sort of like a strobe light, except that it can flash either off or brighter than the usual brightness setting.

The flashing varies from short, quick pulses to slow pulses where it almost goes off completely for a fraction of a second. It will start flashing anywhere from a few seconds after being turned on to about a minute. (B. G., via email).

● This is a strange one. Some of the reasons for this problem could be: (1) The D cell connections could be tarnished, causing a high resistance to the inverter PC board or to the torch negative spring connection. (2) The 47µF tantalum capacitor could be inserted the wrong way or may be faulty. (3) There may be a bad solder joint between the PC board tracks and the MAX1676 IC. (4) The D cell may be discharged to below 0.8V or it is a general purpose type rather than an alkaline type which should perform better. (5) The output voltage is set higher than the recommended 3.9V to 4V max.

As you can see, we are quite puzzled about this fault but we have given you a list of points to check.

Peak hold for tacho circuit

I would like to know whether a peak-hold function could be added to the Auto Tachometer circuit in the April 2000 issue? I would like to use the unit in a Formula 500 Speedway car which is powered by a single cylinder 2-stroke engine.

Different tracks require different gearing and this feature would be ideal for checking for peak RPM, as it becomes very difficult to keep an eye on the tacho when peak revs come at the end of the straight right when you're sliding into corners, trying to avoid cars in front of you while getting mud thrown at your visor etc. (J. H. Perth, WA).

● Unfortunately, the entire program memory contents of the microcontroller in the tachometer circuit has been used to provide for all the features. Without extensive rewriting of the code there is simply no space to include a peak-hold feature.

The accuracy of the peak hold would also be in doubt since many race engines simply change RPM too quickly for a reliable measurement particularly over the 0.6-second update time for your single cylinder 2-stroke engine.

One suggestion would be to set the bargraph to operate over a narrow range of RPM so that peak RPM can be seen as one of the lit LEDs. This will provide a guide as to RPM reached within the limits set for the bargraph.

Lost speedo mode in Speed Alarm

I have built the PIC Speed Alarm from the November and December 1999 issues. The project was well designed and went together easily.

It was perfect for about eight months then one day I turned the key and the display said "dash, dash, dash". Pressing the mode button now gives two choices: dash, dash, dash and speed alarm setting. The unit still works as a speed alarm but there is no speedometer readout. Could the PIC microprocessor somehow have reprogrammed itself? (D. K., via email).

● The speedometer option in the PIC memory has probably been lost due to high temperatures within the car. This can be regained simply by holding the Mode switch closed when power is applied to the Speed Alarm (ie, when the ignition is switched on).

This will select the speedo option again and the display will show an S until the switch is released. This option will again be stored in memory and you will be able to select the speedometer display as before.

Volume control for multi-channel amplifier

I need your help with a problem I am not sure how to resolve. I have just purchased a DVD player with a built-in multi-channel DTS Decoder with analog outputs for all 5.1 channels. I plan on plugging my DVD directly into a 6-channel power amplifier I am building. I am using the LM3876T 50W audio chip for each channel.

Would a 500VA toroidal transformer (25-0-25) with a 35A 400V bridge rectifier and two 20,000µF 50V capacitors as the power supply be sufficient to drive all channels to full power into 8 ohms? Would it be better to have dual power supplies to even the load?

My DVD has volume (gain setup)

for each channel, so all I need is a way of turning up and down the volume. Any ideas? Can you buy a 5 or 6-gang pot for this purpose or is the volume control on most surround sound amplifiers all electronic? The idea of adjusting all six channels at once individually is a bit daunting.

Second problem: I am repairing an old Technics SU-7200 amplifier. It has blown output transistors. They are marked D526 & B596 and are TO-220 devices. I need two of each one. Would you know where I can get replacements? Is there a replacement type (equivalent) I can use instead of the originals?

I also found a cordless handheld mike at a garage sale. It is a Chiayo Q-309 with an Audio Technica capsule fitted. Its frequency is 203.300MHz. I believe this type of mike used a dual diversity receiver system. I wonder if any of your readers could help me with a receiver to match? Is it possible to change the mike frequency to say suit the diversity receiver that appeared in your magazine that used the FM band? K. S., Morphett, SA).

● Your ideas about home theatre parallel our own. In fact, we have just developed a 6-channel infrared remote volume control – planned for publication in the coming March issue. Your power supply concept should be adequate.

We suggest you try WES Components (Phone 02 9797 9866) for your Technics amplifier transistors.

Query on Theremin alignment

I have just completed assembling the Theremin kit described in the August 2000 issue of SILICON CHIP. I am having a little trouble getting it set

Questions on the Ultra-LD Amplifier

The Ultra-LD Amplifier in your latest editions looks very interesting but I have a couple of questions regarding the specifications and possible modifications. Is the distortion rating at 1W output? If so, what's the distortion rating at full rated power? Are the distortion harmonics predominantly low or high order?

Are there any improvements that can be made to the amplifier in the area of sound quality? For instance, I'm not that keen on the crimped connectors but can always attack those with a soldering iron once the kit is up and running.

How does the amplifier respond to an increased bias current? I would prefer to do most of my listening in class A. I'm aware that this would make the fan run more often. Ignoring the background noise issue, are there any problems with increasing the bias a bit?

Finally, you don't seem to be too concerned about any lack of Vbe/gain matching; is there anything to be gained by sourcing matched output transistors? A few people I know love to rant about how anyone can achieve extremely low THD with lots of negative feedback; is there anything to be gained by reducing the amount of feedback and taking other measures to ensure that the amplifier's overall gain is still suitable? (G. W., via email).

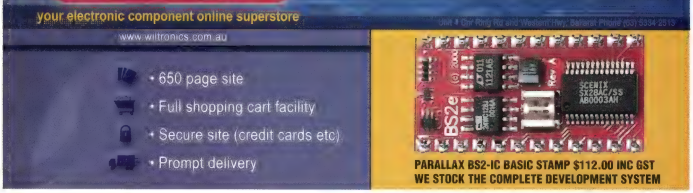
● As you can see from the graphs on pages 62 & 63 of the December 2001 issue, we measured the distortion at 90W across the full audio spectrum (Fig.15) and at 1kHz from 500mW to full power (Fig.16). Distortion at full power at 1kHz is less than .003%. The distortion is predominantly 2nd & 3rd harmonic. We cannot suggest any improvements for sound quality – if there were any, we would have incorporated them. We would not recommend solder connections for the crimped connectors – there is not likely to be any improvement at all.

If you wanted to listen in class-A you would have to increase the bias current to several hundred milliamps. This would greatly increase the overall dissipation in the amplifier and may require an improvement in the heatsinking for the bridge rectifier. It will also increase the hum radiation from the transformer and therefore prejudice noise levels in the amplifier – we wouldn't do it.

The only likely improvement obtained by matching the output transistors would be improved current sharing – there is unlikely to be any other measurable improvement.

Wiring layout is the most critical aspect of a low distortion amplifier. A relatively small change in the wiring layout of the Ultra-LD can easily double the THD! Against that, any playing around with the feedback parameters is fiddling around the edges.

We would strongly advise against making any modifications to the circuit or layout, unless you have access to an Audio Precision System One or similar distortion measuring system and a 100MHz scope, to validate any changes.



PIC project questions

I have a couple of questions regarding two of your PIC based projects:

(1) Is it possible to change the software of the "Automotive Thermometer", published in the October 2001 issue, to indicate tenths of a degree, ie; XX.X? If necessary, a longer 'integration' period would be acceptable.

Also, could the software be changed to automatically toggle between internal/external temperatures – say with a delay of 30-60 seconds? The existing toggle button could still be retained to immediately change the mode and be used for calibration.

(2) I built the "Rain Gauge" (published June 2000) from a Jaycar kit about a year ago. It works well but I would like to know what changes have been made to the software (I notice you have a new version available for download). I would also like to know if the kit design (software/hardware) could be modified to blank the displays during a main power failure; ie, the backup battery would only drive the clock/counter circuitry without wasting power on the LED displays? (C. S., Lemon Tree Passage, NSW).

● The software for the Thermometer could be altered to alternate the display readings between internal and external temperature. Alternatively you could connect up a 555 timer operating as a free running oscillator to "close" the switch momentarily every few seconds.

Measurements of 0.1°C are not possible because this display resolution is not available and also because the sensors do not give 0.1°C accuracy. Most accurate temperature sensors which give 0.1°C accuracy/resolution only operate over a narrow temperature band. These are used for body temperature measurements.

Commercial thermometers claiming 0.1°C accuracy over a -55°C-150°C range using a thermistor sensor are rather optimistic.

The Rain Gauge does not have any facility to shut down the display during a blackout using software. It would require an additional circuit to detect power loss to interrupt the display supply.

up properly. Could this be due to your instructions not explaining how to adjust transformer coil T1? (E. K., via email).

● Coil T1 is not adjusted since all other adjustments are made against this reference frequency. Adjustment of its trimmer slug will result in detuning of the Theremin.

Check the voltages on all oscillator sections of the circuit, at the drains of the JFETS and at the collector of Q4.

Dr Video negative supply query

I recently built the Dr Video Stabiliser from the April 2001 issue but I have not had any success with it. The recorded video is in black and white and is not stable. Both LEDs light up as required but the negative 5V rail measures only 3.5V. Positive 5V is spot on. The circuit board and soldering look OK. The input to the 555 is 11.5V (pins 4 & 8) and I have checked both D2 and D3.

Could the low negative rail be the problem? How do I fix it as I have changed the 555 and both 220µF capacitors? Even with pin 3 open circuit the voltage out of the 555 is only 5.4V. (R. L., via email).

● The circuit won't work without -5V. If your 555 is working properly, you should have about 10V peak-to-peak at pin 3 and about 8-9V at the input to REG2. Are you sure that you do not have a CMOS 555 (eg, 7555) instead of an ordinary 555 which will deliver a lot more current?

Transformer for TENS unit

I am enquiring about the TENS Unit project described in August 1997. I am trying to adapt this to a slightly different application but am having trouble sourcing the EF25 ferrite transformer. Are you able to tell me or put me in touch with the original kit supplier or advise where I might source this from. (R. S., via email).

● The EF25 is now difficult to obtain. You could use the EFD25 which will require some extra holes to be drilled in the PC board. These transformers are available from Farnell. The catalog numbers are 200-300 for the cores (two required), 200-311 for the bobbin and 200-323 fro the clips (two required). Phone New Zealand 64 9 357 0646.

Using ECU signal for speed alarm

I have an enquiry regarding a Digital Speed Alarm kit that I purchased through Jaycar recently. It was described in November & December 1999. The instructions call for the use of a coil and magnets for detection of the speed of the car. My query is can I use the speed sensor wire from the ECU of my car and if so, how? My car is a 1986 VL Commodore. (C. M., via email).

● The speed signal from the car computer can be used to drive the Speed Alarm unit. Simply connect the signal to the 1kΩ resistor input connecting to pin 2 of IC2a. This is instead of connecting L1.

Boosting headphone signals

Have you ever had an article on converting the headphone output of a device to a line level signal suitable for feeding into an audio amplifier? I have a laptop which has a composite TV out signal but only a headphone socket for audio. It would be nice to be able to hook the entire thing into the home theatre. (M. C., via email).

● Have a look at the PreChamp featured in July 1994 (also featured on page 36 of the October 2001 issue); you will need two for stereo. You probably only need a gain of 10 or so, so the 100Ω resistor at the emitter of Q1 should be changed to 220Ω or 270Ω.

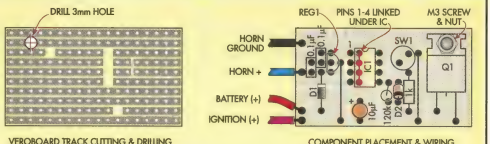
Beat triggered strobe does not work

I recently brought a Beat-Triggered Strobe project, as published in the August 1998 issue of SILICON CHIP. I got it together fine and it worked fine on oscillator for a day or two. Then I mounted it in the box and decided to try the line input and I got nothing.

I spent some time checking the circuit, PC board layout etc and I noticed

Notes & Errata

Motorbike Alarm, January 2002: the Veroboard layout shown on page 56 contains a number of errors. The correct layout for both the copper pattern and the parts overlay is shown at right.



that the circuit specified a 1µF capacitor just after D1 but in the PC board layout diagram it specified a 100µF (which was supplied). I put in a 1µF unit and that fixed it for about 10 minutes, then it stopped altogether.

All that happens now is that the neon goes on, permanently. I did some testing and I think the neon is staying on because the 0.1µF 250VAC in series with T2 is only discharging to about 68V. Beyond that, I have no idea what's wrong. Can you help please? (T. D., via email)

● The capacitor at the cathode of D1 should be 1µF. Trigger transformer T2 is probably at fault. Replace this and the circuit should work.

Check the voltages across the 0.1µF capacitor and the 6.5µF capacitors before working on the circuit. A high voltage across them could give a nasty electric shock.

Video colour inverter wanted

I am a student at Swinburne University, Melbourne. I am currently doing a project involving video editing and production. I am looking for a video colour inverter to add in those effects I have sometimes seen on TV. I was wondering if you had a kit or project that takes a standard composite video signal and inverts the colours. (G. W., via email).

● While we have not described a video inverter project, you could adapt the circuit of the Video Fader we published in August 1993. You need to strip the sync off the video signal, invert the video and then add the sync back again. The August 1993 circuit will show you how. We can supply this issue for $7.70 including postage.

Stepper motor control needed

I am after a circuit that controls a 12V motor. It would control the number of turns in either direction the motor can make; ie, I want the motor to complete 50 revolutions in a clockwise or anti-clockwise direction. It would also allow the number of revolutions to be stored for later retrieval (multiple storages would be nice). Basically, I want to be able to open and close curtains using a motor and be able to open them a preset amount.

Do you know of a circuit that would suit my needs and where I could get it? (B. S., via email).

● We published a number of articles on Stepper Motor control from a PC during 1997 but one entitled "Manual Control Circuit For A Stepper Motor" in the June 1997 issue is probably the most appropriate for your application. It will drive a stepper motor in one direction or the other for a fixed time. We can supply the issue for $7.70 including postage.

Extra inputs for AV distribution amplifier

I would like to add additional (switchable) inputs for the AV Distribution Amplifier project (November 2001) to cope with the situation of, say, using a Cable TV box, two VCRs and a DVD feeding a TV and also feeding the output back to the VCR's line-input for recording/dubbing, plus (sound) to a hifi system. This situation must be quite a usual setup in the home and would cope with recording the 'input' device at any time, whether the TV was on or off.

Is it just a case of buying a video switch box to use before the distribution amplifier or is there a more elegant solution? Or indeed has a project been designed for this purpose? (B. F., Brighton, Vic).

● The best way is to use an AV switch box ahead of the distribution amplifier, as you suggest. Trying to build input source switching into the amplifier would be messy. A switch box should be fine. **SC**

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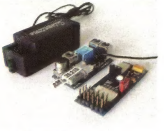

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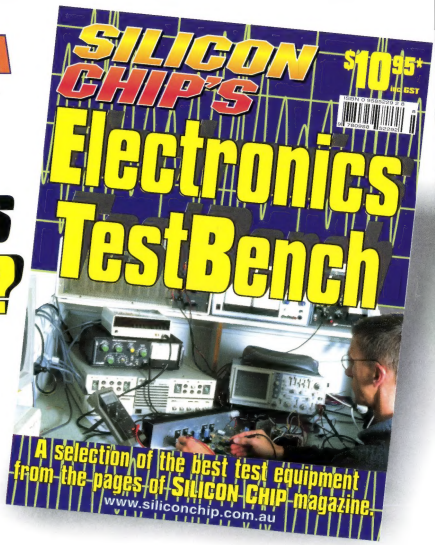

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